Metro Tel Corp

ddi Brand Test Sets

MODELS 100R-4 and 100R-5

TRANSMISSION TEST SETS

Instruction Manual & Installation Drawings

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All products are warranted against defects in materials and workmanship for 1 year from date of shipment. Our obligation covers repairing or replacing parts which prove to be defective during the warranty perod and which shall be returned with transportation charges prepaid to Metro Tel Corp. Obligation is limited to the original purchaser. Warranty repairs will be made at no cost to the customer, provided that the products have not been subjected to improper installation, misuse, accidental damage or alteration without authorization. We are not liable for consequential damages.

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SECTION 1
GENERAL DESCRIPTION

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1.0 GENERAL DESCRIPTION

A. Introduction

1.01 The test sets described in this manual perform all of the common measurement functions required for telephone office maintenance. These instruments, available in various measurement configurations, are intended for use in test boards, carrier lineups, or miscellaneous equipment bay lineups. The equipment design employs advanced microprocessor technologies, and places prime emphasis on high reliability, simplicity of operation, and low power consumption.

1.02 The Design Development Inc. Models 100R-2W, 100R-4 and 100R-5 are Transmission Test Sets (TTS) with similar but not identical measurement capabilities. These are described in paragraph 1.03. The Model 100R-6, used for 2-wire and 4-wire return loss measurements, is described in paragraph 1.09. Since the Model 100-R4 can also perform return loss measurements in addition to transmission measurements, paragraph 1.09 also applies to it. The measurement features of all models are summarized in Table 1-1.

B. Transmission Measurements

1.03 Models 100R-2W, 100R-4 and 100R-5 provide accurate measurement of level, noise, and frequency. These test sets include the ability to send sinewave signals from a wideband audio oscillator that is independent of the measuring circuits.

1.04 The level receiver input circuits provide for terminated (600 or 900 ohms) or bridging measurements, pushbutton selectable. The receiver autoranging circuit enables level measurements without manual switching. A separate frequency readout provides a simultaneous display in kHz (with autoranging) of the level being measured.

1.05 Noise measurements are made using the same circuits and displays employed for level measurements. The frequency display is blanked for noise measurements. Pushbutton selection is provided for C message, 3 kHz flat, and 15 kHz flat noise filters, and also a 1010 Hz noise notch filter. In addition, Models 100R-4 and 100R-5 can measure noise-to-ground through a range of 135 to 40 dBrn, and includes a pushbutton-selectable band pass filter (0.2 to 5 kHz) for interference protection.

1.06 The audio oscillator provides 3 pushbutton-selectable preset test frequencies (404, 1004, and 2804 Hz) and 2 preset levels (0, -16 dBm) on Models 100R-4 and 100R-5. The Model 100R-2W has 3 preset levels (0, -2, -16 dBm). Variable controls provide a range of 100 Hz to 20 kHz for frequency, and -40 to +10 dBm for level.

1.07 An optional aisle display, Model 100A-3, can be used with Models 100R-4 and 100R-6 to display level, noise, frequency, and return loss readings. The aisle display is readable up to 30 feet away. The Model 100R-2W and 100R-5 use the optional Model 100-A2W Aisle Display to display level, noise, and frequency readings for remote viewing up to 30 feet away. In addition, the Model 100R-2W and 100R-5 can be used with the Model 100C-2W combiner. This unit (optional) combines 8 TTS units (expandable) to up to 12 aisle display runs (expandable). This means that any TTS unit can switch to and work in any aisle and all TTS operators can be working separately of each other at all times, with no sharing or contention for a meter.

1.08 Each instrument is inspected both mechanically and electrically prior to shipment. All models operate from a -48 VDC power supply. Each unit occupies only 1-3/4 inches of rack space height (1 rack space) in a 19 or 23-inch wide rack.

TABLE 1-1. MODEL FEATURES

FEATURES	MODEL					
	100R-2W	100R-4	100R-5	100R-6	100A-3	100-A2W
Level meas.	•	•	•		•	•
Frequency meas.	•	•	•		•	•
Noise meas.	•	•	•		•	•
Noise-to-ground		•	•		•	
Talk/dial/hold		•	•	•	n/a	n/a
Oscillator	•	•	•		n/a	n/a
Return loss 2W/4W		• #		•	•	
Monitor speaker			•		n/a	n/a
External audio monitor	•	•	•	•	n/a	n/a

n/a = not applicable
= Return loss functions indicated by red lettering on front panel

C. Return Loss Measurements

1.09 The return loss functions of Models 100R-4 and 100R-6 provide a direct readout of both 2-wire and 4-wire Echo Return Loss (ERL), Singing Return Loss Los (SRL LO), and Singing Return Loss High (SRL HI). For ERL measurements, a white-noise test signal between 560 and 1965 Hz is used. SRL is measured on two bands, 260 to 500 Hz for SRL LO, and 2200 to 3400 Hz for SRL HI. Individual impedance selection is provided for both 2-wire (600 or 900 ohms) and 4-wire (600 ohms) on the front panel.

1.10 Pushbutton switches control the selection of the noise spectrum filters. The front panel also provides thumbwheel switches for setting the Trans Hybrid Loss (THL) correction. This allows the craftsperson to obtain an actual true reading without additional calculation when measuring on a 4-wire circuit.

1.11 The return loss receiver is similar to that previously described for Level/Noise. A built-in bandpass protection filter prevents low and high frequencies out of the band of interest from affecting the return loss reading. This filter is pushbutton-selected on the front panel.

D. Talk/Dial/Transfer/Hold

1.12 Models 100R-4 and 100R-5 provide for simultaneous transmit and receive operation. A tone can be transmitted on one circuit, while an incoming tone (or noise) is measured on another circuit. A dial jack allows the craftsperson to dial up and hold a circuit when making a level, noise, or return loss test, for example. When the test is complete in one direction, a pushbutton switch on the front panel is used to reverse the transmit/receive direction. The Talk/Dial/Hold feature is used on the Model 100R-6 to dial up an office balance termination number (Code 100).

E. Specifications.

1.13 Specifications for Models 100R-2W and 100R-5 are listed in Table 1-2. Specifications for Models 100R-4 and 100R-6 are provided in Table 1-3, and for the Model 100A-3 and 100A-2W Aisle Displays in Tables 1-4 and 1-5.

TABLE 1-2
SPECIFICATIONS
FOR MODELS 100R-2W AND 100R-5

LEVEL:

Input Range:	-50 to +10 dBm, autoranging (Model 100R-2W) -50 to +15 dBm, autoranging (Model 100R-5)
Resolution:	0.1 dB
Frequency Response:	±0.1 dB, 100 Hz to 20 kHz
Sampling Rate:	5 times per second
Detection Method:	full-wave averaging
Accuracy:	±0.1 dB
Blanking:	+ sign for overrange - sign for underrange (digits are blanked in both cases)
Damping:	similar to analog meters

FREQUENCY MEASUREMENTS:

Range:	Autoranging with two ranges: Below 100 Hz to 9.999 kHz, 9.00 kHz to 30 kHz
Display:	Four-digit .43" LED, displays for level measurements
Sampling Rate:	5 times per second
Accuracy:	1 count ± one part in 10^6
Resolution:	1 Hz or 10 Hz, autoranging

NOISE:

Input Range:	0 dBrn to 60 dBrn (Model 100R-2W) 0 dBrn to 95 dBrn (Model 100R-5)
Resolution:	1 dB
Noise Filters:	'C' message, 3 kHz, 15 kHz and 1010 noise notch (standard) 15 kHz is replacable if desired
Detector:	Ouasi RMS
Accuracy:	± 1dB from 95 dBrn to 20 dBrn; ±2 dB from 20 dBrn to 10 dBrn
Reading Update Rate:	2½ times per second
Blanking:	+ sign for overrange - sign for underrange digits are blanked in both cases
Frequency Display:	Automatically blanked for noise measurement.

NOISE TO GROUND (Model 100R-5 only)

Range (at 600 ohms and 900 ohms)	135 to 40 dBrn
Resolution:	1 dB
Accuracy:	±1.5 dB, 130 dBrn to 50 dBrn

OSCILLATOR:

Frequency Range:	Variable from 100 Hz to 20 kHz in two ranges: 100 Hz to 4 kHz, and 4 kHz to 20 kHz
Programmed Frequencies:	Up to 3 within the oscillator range. Standard frequencies supplied are 404, 1004, 2804 Hz.
Level Range:	From -40 to +10 dBm
Programmed Levels:	Up to 2 (Model 100R-5) or 3 (Model 100R-2W), and variable. Standard levels are 0, and -16 dBm (Model 100R-5 or 0, -2 and -16 dBm (Model 100R-2W)
Level Variation:	±0.1 dB, 200 Hz to 20 kHz
Harmonic Distortion:	1% total, 100 Hz to 20 kHz, Less than 0.5% at 1004 Hz
Output Impedance:	600 or 900 ohms balanced

GENERAL (Model 100R-5 only):

Input and output impedance is 600 ohms with 30 dB minimum return loss using the ERL or SRL spectrums. Longitudinal balance exceeds 50 dB from 50 Hz to 60 kHz.

Talk/Dial/Transfer/Hold:

S/R Dial Jack:	Allows operator to dial up and hold 2-wire circuit.
Hold button:	Allows holding on SEND or RCV jack
Normal/Transfer button:	Allows operator to reverse the transmit/receive direction
DISP button:	Allows operator to monitor oscillator output or receive input signals
Selectable Input:	600 ohms or 900 ohms, terminated or bridging
Bridging Loss:	Less than 0.2 dB
Reading Response:	Similar to analog meters
Audio Monitor:	Level or noise, rear access wiring option.
Power ON/OFF:	Switch in rear panel
Access:	310 Jacks standard with 5/8" spacing. Tip-spring & Ring-spring contacts for both level and oscillator inputs/outputs on back.

GENERAL (Model 100R-2W only):

Selectable Input:	600 ohms or 900 ohms, terminated or bridging
Bridging Loss:	Less than 0.2 dB
Reading Response:	Similar to analog meters
Audio Monitor:	Level or noise, rear access wiring option.
Power ON/OFF:	Switch on rear panel.
Cal Send:	Rear access wiring option
Access:	310 jacks standard with 5/8" spacing. Tip-spring & Ring-spring contacts for both level and oscillator inputs/outputs on back panel.

INPUT POWER:

Power Supply:	-44 Vdc to -54 Vdc
Current Drain:	300 mA nominal at -48 Vdc
DIMENSIONS:	17" W x 9¼" D x 1¾" H
Mounting:	19" or 23" rack (reversible rack ears supplied standard).
TEMPERATURE RANGE (Operating):	10° C to 40° C

TABLE 1-3
SPECIFICATIONS
For Models 100R-4 and 100R-6

LEVEL (Model 100R-4 only):

Input Range:	-50 dBm to +15 dBm (autoranging)
Resolution:	0.1 dB
Variation with frequency:	±0.1 dB, 100 Hz to 20 kHz
Detector:	Full wave average
Reading update rate:	5 times per second
Blanking:	+ sign for overrange - sign for underrange Digits are blanked in both cases
Damping:	Similar to analog meters
Accuracy:	±0.1 dB

FREQUENCY (Model 100R-4 only):

Range:	Autoranging with two ranges: Below 100 Hz to 9.999 kHz; 9.99 kHz to 30 kHz
Display:	Four digit .43 in. LED, displays digits whenever level is read
Reading update rate:	5 times per second
Accuracy:	1 count plus one part in 10^6
Resolution:	Autoranging, 1 Hz or 10 Hz

NOISE (Model 100R-4 only):

Input range:	0 dBrn to 95 dBrn
Resolution:	1 dB
Noise filters:	'C' message, 3 kHz, 15 kHz and 1010 noise notch
Detector:	Quasi RMS
Accuracy:	±1 dB 95 to 20; ±2 dB 20 to 10 dBrn
Reading update rate:	2½ times per second
Blanking:	+ sign for overrange - sign for underrange digits are blanked in both cases
Frequency display:	Automatically blanked for noise measurement

NOISE-TO-GROUND (For Models 100R-4 only):

Range (@600 ohms and 900 ohms)	135 to 40 dBrn
Resolution	1 dB
Accuracy	±1.5 dB, 130 dBrn to 50 dBrn

LEVEL AND NOISE (Model 100R-4 only):

Selectable Input:	600 ohms or 900 ohms, terminated or bridging
Bridging loss:	Less than 0.2 dB
Reading response:	Similar to analog meters
Audio monitor:	Level or noise, rear access wiring option

OSCILLATOR (Models 100R-4 only):

Frequency range:	Variable from 100 Hz to 20 kHz in two ranges; 100 Hz to 4 kHz, and 4 kHz to 20 kHz
Programmed frequencies:	Up to 3 within the oscillator range. Standard frequencies supplied are 404, 1004, 2804 Hz
Level range:	From -40 to +10 dBm
Programmed levels:	Up to 2 and variable. Standard levels are 0 and -16 dBm.
Level variation:	±0.1 dB, 200 Hz to 20 kHz
Harmonic distortion:	1% total, 100 Hz to 20 kHz. Less than 0.5% at 1004 Hz

RETURN LOSS:

TRANSMITTER:

Output level:	Switch selectable -2 dBm ±0.2 dB or -18 dBm ±0.3 dB

TEST SIGNALS:

White noise, band limited by three filters as described below:

Echo return loss:	560-1965 Hz (-3 dB)
Singing return loss low:	260-500 Hz (-3 dB)
Singing return loss high:	2200-3400 Hz (-3 dB)

Variation in power level when switching filters: ±0.1 dB max.

RECEIVER:

Return loss range:	-15 dB (+15 ret. gain) to +50 dB
Resolution:	1 dB
Overall accuracy:	±1 dB to 40 dB; ±2 dB to 50 dB return loss
Reading update rate:	2½ times per second
Trans-hybrid loss correction range:	0 to 29.9 dB in 0.1 dB steps
Interference protection filter:	Bandpass 200-5000 Hz. Rejects below 60 Hz and above 56 kHz > 40 dB. The filter is included as a standard feature (pushbutton selectable)

2-WIRE:

Accuracy:	±1 dB
Compromise network accuracy:	600/900 ±0.1%, +2.16μF ±1%. Dial and Hold circuits provided (pushbutton selectable)

GENERAL

Input and output impedance is 600 ohms with 30 dB minimum return loss using the ERL or SRL spectrums. Longitudinal balance exceeds 50 dB from 50 Hz to 60 kHz.

Talk/Dial/Transfer/Hold:

S/R Dial Jack:	Allows operator to dial up and hold 2-wire circuit
Hold button:	Allows holding on SEND or RCV jack
NORM/Transfer button:	Allows operator to reverse the transmit/receive direction
Audio Monitor:	Level or noise, rear access wiring option.
Power ON/OFF:	Switch on rear panel
Access:	310 jacks standard with 5/8" spacing. Tip-spring & Ring-spring contacts for both level and oscillator inputs/ outputs on back panel.

INPUT POWER:

Power supply:	-44 Vdc to -54 Vdc
Current Drain:	300 mA nominal at -48 Vdc
DIMENSIONS:	17" W x 9¼" D x 1¾" H
Mounting:	19" or 23" rack (reversible rack ears supplied standard)
TEMPERATURE RANGE (Operating):	10° C to 40° C

TABLE 1-4
SPECIFICATIONS FOR
MODEL 100A-3 AISLE DISPLAY

Power:	-48 Vdc external source fused at 1 amp
Current Drain:	175 mA nominal at -48 Vdc
Displays:	1" high LED displays
Cable Requirements:	1 pair (2 wires) unshielded 22 ga. maximum distance 100A-3 to TMS or any combination multiple run is 10,000 feet
Number of Units:	Up to 50 per installation (system)
Dimensions:	Overall, 11.5" W x 9.5" H x 2" D
Position Served Indicator:	0.43" high LED

NOTE: Model 100A-3 is for use with Models 100R4 or 100R6 Test Sets for remote viewing up to 30 feet away.

Temperature Range (Operating):	10° C to 40° C

TABLE 1-5
SPECIFICATIONS FOR
MODEL 100A-2W AISLE DISPLAY

Power:	-48 Vdc external source fused at 1 amp
Current Drain:	175 mA nominal at -48 Vdc
Displays:	1" L.E.D. displays
Cable Requirements:	1 pair (2 wires) unshielded 22 ga maximum distance 100A-2W to combiner or any combination multiple run is 10,000 feet
Number of Units:	Up to 100 per installation (system)
Dimensions:	Overall, 11.5" W x 9.5" H x 2" D
Position Served Indicator:	0.43" LED

SECTION 2
INSTALLATION

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2.0 INSTALLER'S INSTRUCTIONS

A. Introduction

2.01 This section contains the instructions for installation and interconnection of the Model 100R Series and optional aisle display units. The instructions include:

(a) Receiving inspection.
(b) Equipment mounting.
(c) Installer connections.
(d) Built-in options.
(e) Operational checks.

B. Receiving Inspection

2.02 Remove the instrument from the shipping carton and carefully inspect it for physical damage that may have occurred during transit. If the unit is damaged, file a claim with the transfer company. The original packaging should be retained to facilitate any damage claim.

C. Equipment Mounting.

2.03 Refer to the outline drawings on pages 7-11 through 7-16 of this manual. The Model 100R Series mounts into one rack space (1-3/4-inch vertical height). All units are supplied with reversible rack mounting ears for either 19- or 23-inch mounting. Each unit requires a rack depth of 9 inches.

2.04 The aisle display units (optional) may be positioned for overhead viewing by mounting it using a 5/8-inch threaded rod (see page 7-16). The display unit top hanger assembly can also be used for wall mounting, or from either side for bay mounting.

D. Installer Connections

2.05 Before proceeding with the installation, refer to pages 2-2 and 2-3 of this manual to determine the equipment location, cable runs required, and which wiring options are to be installed.

2.06 Input power connections are made at the rear panel terminal screw block. The wire size and terminal connections are shown on the CAD drawings on pages 7-3 through 7-7 of this manual. It is recommended that the -48 Vdc source to each unit be fused at 1 amp. Refer to the power cabling diagram of the -48 Vdc office fuse panel on page 7-10.

E. Built-In Options

2.07 Paragraphs 2.08 through 2.11 describe the built-in options that may be wired in during installation as specified by the job engineer.

2.08 **Test Board and Misc. Jack Multiples:** As an option, the tip-spring and the ring-spring of both the oscillator output and the level/noise input can be accessed through rear panel connector TS1 on Models 100R-2W, 100R-4, and 100R-5. This is useful, for example, for operation of a test board with a TMS or oscillator key connection. See pages 7-4 through 7-6 for pin location.

2.09 Audio Monitor, Models 100R2W, R4, R5, R6: An audio monitor of the level or noise signal being measured is present at TS1 connector (see pages 7-4 through 7-7 for the appropriate pin location).

2.10 Dial Jack, Models 100R4, R5, R6: These models have a 2-wire dial jack that allows the operator to dial up and hold a circuit when making a level, noise, or return loss test. The tip-spring and ring-spring also appear on the back at TS1 (see pages 7-5 through 7-7 for pin locations).

2.11 Remote Display: Connector TS1 at the rear of the Model 100R series provides the output signals for operation of optional Models 100A-2W or Model 100A-3 depending on the application. Connections are made through standard wirewrap pins, except for the Model 100A-2W &

100A-3, which both have screw terminals. Both mount using a standard 5/8-inch threaded rod or rack mounting using the bracket on the right or left side mounting arrangement. See pages 7-8 and 7-9 for cross-connect wiring.

F. Operational Checkout

2.12 After the installation has been completed, make an operational check of the equipment using the performance verification procedures in Section 3 following.

INSTALLER PLEASE READ BEFORE PROCEEDING

1. All wiring detail is show in Section 7, the Installation Drawing package.
2. A separate job installation document should be provided for you by the Job Engineer/Customer showing equipment relay rack location, fusing, cable runs, wiring options, etc. in order to proceed with the installation.
3. Tables 2-1 and 2-2 list the customer wiring options which are available at time of installation.

Table 2-1 Model 100R-2W Only

WIRING OPTION	DESCRIPTION OF OPTION	REFERENCE LOCATION		PROVIDE YES	PROVIDE NO
N,P (RCV) (AUX) R,S (SEND) (AUX)	Misc. jack multiple	Section 7 Page 7-4 Sheet 3			
H,J (monitor)	Audio monitor to high impedance speaker amp	Section 7 Page 7-4 Sheet 3			
(X) Pin E,F	DC loop holding for oscillator	Section 7 Page 7-4 Sheet 3			
(Y) A - C B - D	Cal Pushbutton key (provided strapped from factory)	Section 7 Page 7-4 Sheet 3		X	
TABLE 1 STRAPPING OPTION	POSITION SERVED INDICATION provided when used with 100C-2W Combiner	Section 7 Page 7-4 Sheet 3			

Table 2-2 Models 100R-4, 100R-5, 100R-6

WIRING OPTION	DESCRIPTION OF OPTION	REFERENCE LOCATION		PROVIDE YES	PROVIDE NO
K,L (RCV) (AUX) N,P (SEND) (AUX) F,H (Dial)	Misc jack multiple	Section 7 Pages 7-5, 7-6, 7-7 Sheets 4, 5, 6			
R,S (monitor)	Audio monitor to high impedance speaker amp	Section 7 Pages 7-5, 7-6, 7-7 Sheets 4, 5, 6			
TABLE 1	POSITION SERVED INDICATION provided when used with 100C-2W Combiner	Section 7 Pages 7-4 thru 7-7 Sheets 3 thru 6			
C,D (NET)	N1, N2 connections for Precision External Network	100R-4, R6 only; Section 7 Pages 7-5, 7-7 Sheets 4 & 6			
A, B EXT OSC INPUT		Section 7 Page 7-7 R6 only Sheet 4			

SECTION 3
PERFORMANCE VERIFICATION

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3.0 PROCEDURES

A. Introduction

3.01 The procedures in this section enable the craftsperson to check that the equipment is operating properly. These checks should be performed after installation is complete, and may also be used for periodic checkout if required by office procedures.

3.02 There are six 10-turn potentiometers on the rear panel of the instrument. These controls adjust the oscillator fixed levels of 0, -2, (Model 100R-2W), and -16 dBm, and fixed frequencies of .404, 1.004, and 2.804 kHz.

B. Performance Verification Procedures

3.03 The procedures are organized as follows:

(a) Model 100R-2W, Procedure 3-1.
(b) Model 100R-4, Procedure 3-2.
(c) Model 100R-5, Procedure 3-3.
(d) Model 100R-6, Procedure 3-4.

CAUTION:
Do not begin the procedure until the equipment has warmed up for a period of 2 to 3 hours. This is necessary to ensure optimum stability of readings.

PROCEDURE 3-1.
MODEL 100R-2W PERFORMANCE VERIFICATION

STEP	PROCEDURE
1	Patch from the **SEND** jack to the **RCV** jack using a standard telephone patchcord.
2	Set the **600/900** toggle switch to **600.**
3	Press the bottom **IMPEDANCE 600** pushbutton. Press the **INPUT TERM** and **dBm LEVEL** pushbuttons. Press the **OSC LEVEL 0** and **OSC FREQ 1004** pushbuttons.
4	Check that the level display reads 0.0 dBm and the frequency display 1.004 kHz. If not, on the rear panel adjust the LEVEL 3 control for a 0.0 dBm reading. If necessary, adjust the FREQ 2 control to obtain a reading of 1.004 kHz.
5	Press the **OSC FREQ 404** pushbutton. Check that the frequency display reads .404 kHz. If not, adjust the FREQ 3 control.
6	Press the **OSC FREQ 2804** pushbutton. Check that the frequency display reads 2.804 kHz. If not, adjust the FREQ 1 control.
7	Press the **OSC LEVEL -2** pushbutton. Check that the level display reads -2.0 dBm. If not, adjust the LEVEL 2 control.
8	Press the **OSC LEVEL -16** pushbutton. Check that the reading is -16.0 dBm. If not, adjust the LEVEL 1 control.
9	Remove the patchcord from the **SEND** and **RVC** jacks. This completes the operational check of the unit.

PROCEDURE 3-2.
MODEL 100R-4 PERFORMANCE VERIFICATION

CAUTION:
Do not begin the procedure until the equipment has warmed up for a period of 2 to 3 hours. This is necessary to ensure optimum stability of readings.

STEP	PROCEDURE
1	Patch from the **SEND** jack to the **RCV** jack using a standard telephone patchcord.
2	Select the front panel pushbutton as follows: **RCV SEND DISP** to **RCV.** **NORM XFR** to **NORM** **OFF ON HOLD** to **OFF** **S/R DIAL** to **S/R** Oscillator **IMPEDANCE 600** **OSC LEVEL 0** **OSC FREQ 104** Level **IMPEDANCE 600** **INPUT TERM** **dBm LEVEL** **4WTLP** to **O/O** **2W NET** to **INT** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** **THL CORRECT 4W thumbwheels** to **00.0**
3	Check that the level and frequency displays read 0.0 dBm and 1.004 kHz, respectively. If necessary, adjust the LEVEL 2 and FREQ 2 controls for the correct readings.
4	Press the **OSC FREQ 404** pushbutton. Check that the display reads .404 kHz. If necessary, adjust the FREQ 3 control.
5	Press the **2804** pushbutton. Check for a reading of 2804. If not, adjust using the FREQ 1 control.
6	Press the **OSC LEVEL -16** pushbutton. Check for a -16.0 dBm reading. If not, use the LEVEL 1 control for adjustment.
7	Remove the patchcord (step 1), then press the **L/N RL** pushbutton so that **RL** is selected. Press the **CIRCUIT TYPE 2W 600** pushbutton. Check that the return loss display reads 0 dB. If not, adjust using the LEVEL 3 control until + and - signs are alternating.
8	Patch from the **SEND** to the **RCV** jack using a standard telephone cord.
9	Press the **CIRCUIT TYPE 4W 600** pushbutton. Check that the **THL CORRECT 4W** thumbwheels are set to 00.0. Check that **4WTLP** pushbutton is in **0/0** position. Check that the return loss display reads 0 dB. If this can not be obtained, check to make sure that the patchcord being used does not have a higher than normal resistance, or has a dirty plug.
10	Press the **4WTLP** pushbutton so that it is in the -16/+7 position. Check that the display reads +23 dB. Set the **THL CORRECT 4W** thumbwheels to 23.0. Check that the display reads 0.
11	Remove the patchcord from the **SEND** and **RCV** jacks. This completes the operational checkout of the Model 100R-4.

PROCEDURE 3-3.
MODEL 100R-5 PERFORMANCE VERIFICATION

CAUTION:
Do not begin the procedure until the equipment has warmed up for a period of 2 to 3 hours. This is necessary to ensure optimum stability of readings.

STEP	PROCEDURE
1	Patch from the **SEND** jack to the **RCV** jack using a standard telephone patchcord.
2	Select the front panel pushbuttons as follows: **RCV SEND DISP** to **RCV.** **NORM XFR** to **NORM** **OFF ON HOLD** to **OFF** **S/R DIAL** to **S/R** Oscillator **IMPEDANCE 600** **OSC LEVEL 0** **OSC FREQ 1004** Level **IMPEDANCE 600** **INPUT TERM** **dBm LEVEL** **BP 0.2-5 kHz** to **OUT**
3	Check that the level and frequency displays read 0.0 dBm and 1.004 kHz, respectively. If necessary, adjust the LEVEL 2 and FREQ 2 controls for the correct readings.
4	Press the **OSC FREQ 404** pushbutton. Check that the display reads .404 kHz. If necessary, adjust the FREQ 3 control.
5	Press the **2804** pushbutton. Check for a reading of 2804. If not, adjust using the FREQ 1 control.
6	Press the **OSC LEVEL -16** pushbutton. Check for a -16.0 dBm reading. If not, use the LEVEL 1 control for adjustment. Remove the patchcord from the **SEND** and **RCV** jacks. This completes the operational checkout of the Model 100R-5.

PROCEDURE 3-4.
MODEL 100R-6 PERFORMANCE VERIFICATION

CAUTION:
Do not begin the procedure until the equipment has warmed up for a period of 2 to 3 hours. This is necessary to ensure optimum stability of readings.

STEP	PROCEDURE
1	Select the front panel pushbuttons as follows: **NORM XFR** to **NORM** **OFF ON HOLD** to **OFF** **S/R DIAL** to **S/R** **CIRCUIT TYPE** to **2W 600** **TEST** to **ERL** **4WTLP** to **0/0** **2W NET** to **INT** **BP 0.2-5 kHz** to **OUT** **THL CORRECT** thumbwheels to **0.0**
2	Check that the return loss display reads 0 dB. If not, adjust using the LEVEL 3 control on the rear panel until the + and - signs are alternating.
3	Patch from the **SEND** jack to the **RCV** jack using a standard telephone patchcord.
4	Press the **CIRCUIT TYPE 4W 600** pushbutton. Check that the **THL CORRECT 4W** thumbwheels are set to 00.0. Check that the **4WTLP** pushbutton is in the **0/0** position. Check that the display reads 0 dB. If this cannot be obtained, make sure that the patchcord being used does not have a higher than normal resistance, or has a dirty plug.
5	Press the **4WTLP** pushbutton so that it is in the **-16/+7** position. Check that the display reads +23 dB. Adjust the **THL CORRECT 4W** thumbwheels to 23.0. Check that the display reads 0.
6	Remove the patchcord from the **SEND** and **RCV** jacks. This completes the operational checkout of the Model 100R-6.

SECTION 4
OPERATION

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4.0 OPERATING PROCEDURES

A. Introduction

4.01 This section contains information on the proper use of the test set to obtain accurate measurements. Separate procedures including diagrams are provided for each measurement type.

B. Function of Controls and Indicators

4.02 Table 4-1 lists the function of the controls and indicators for the Model 100R-4. This table also applies to Models 100R-2W and 100R-5 for the level, noise, frequency and send oscillator functions, except where noted otherwise. Table 4-1 also applies to the Model 100R-6 to describe the return loss function. The controls and indicators are listed in numerical order as identified in Figure 4-1 following.

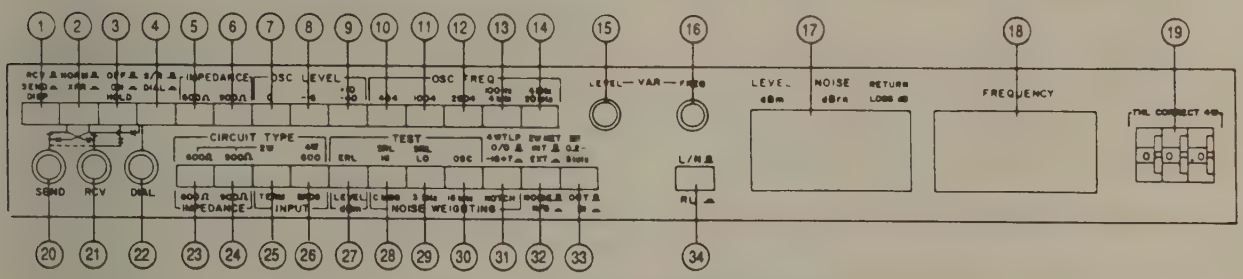


Figure 4-1. CONTROL AND INDICATORS

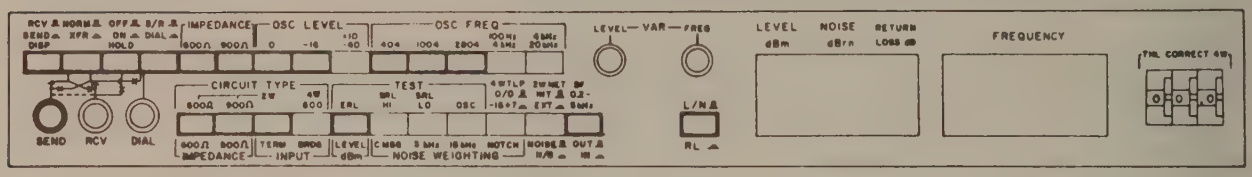
TABLE 4-1. FUNCTION OF CONTROLS AND INDICATORS

NO.	FUNCTION	NOTES
1	In the RCV position, connects the receive circuits to monitor and display level/frequency or noise signal on front panel display. In SEND position, connects receive circuits to monitor and display oscillator output.	Not 100R-2W
2	In NORM position, provides normal connection to SEND and RVC jacks. In XFR position, reverses internal connections to SEND and RCV jacks.	"

3	In OFF position, removes internal hold circuits from SEND and RCV jacks. In ON position, provides circuit holding for a 2-wire facility, on both jacks.	Not 100R-2W
4	In S/R position, provides normal send/receive operation. In DIAL position, allows talk/dial operation when test board position circuit or dial set is plugged into DIAL jack.	"
5	Selects 600 ohm oscillator output impedance.	Toggle switch on 100R-2W
6	Selects 900 ohm oscillator output impedance.	"
7	Selects 0 dBm oscillator output level	100R-2W also has -2 dBm level select.
8	Selects -16 dBm oscillator output level	
9	Selects continuously variable oscillator output level, as set by VAR LEVEL control.	
10	Selects .404 kHz oscillator output freguency.	
11	Selects 1.004 kHz oscillator output frequency.	
12	Selects 2.804 kHz oscillator output frequency.	
13	Selects continuously variable oscillator output frequency between 100 Hz and 4 kHz as set by VAR FREQ control.	Toggle switch on 100R-2W
14	Selects continuously variable oscillator output frequency between 4 kHz and 20 kHz, as set by VAR FREQ control.	"
15	Sets oscillator output level when OSC LEVEL VAR selected.	
16	Sets oscillator output level when OSC FREQ VAR selected.	
17	Digital display for level, noise, or return loss. LED indicates mode displayed.	
18	Digital display for frequency in kHz.	
19	Thumbwheel switches to set transhybrid loss from 00.0 to 29.9 dB for 4-wire return loss measurements.	Not 100R-2W or 100R-5
20	Type 310 jack for send oscillator output or return loss transmit.	No return loss 100R-2W, 100R-5
21	Type 310 jack for level/frequency or noise input, or return loss receive.	"
22	Type 310 jack to patch into test board position circuit or dial set.	Not 100R-2W

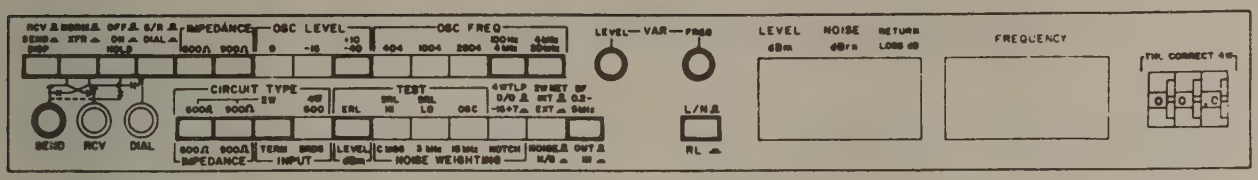
23	Selects 600 ohm impedance for level/noise or 600 ohm, 2-wire return loss depending on position of L/N RL pushbutton.	No return loss 100R-2W, 100R-5
24	As above for number 23, except for 900 ohm selection.	"
25	Selects terminated (600 or 900 ohms) input for level/noise with L/N RL pushbutton in L/N position. Selects 2-wire return loss measurement with L/N RL pushbutton in RL position.	" "
26	Selects bridging connection for level/noise measurements with L/N RL pushbutton in L/N position. Selects 4-wire return loss measurement with L/N RL pushbutton in RL position.	" "
27	Selects level and frequency display of input at RCV jack, with L/N RL pushbutton in L/N position. Selects echo return loss band for return loss measurement with L/N RL pushbutton is in RL position.	 No return loss 100R-2W,100R-5
28	Selects noise measurements with C message weighting when L/N RL pushbutton in L/N position. Selects singing return loss high band when L/N RL pushbutton is in RL position.	 "
29	Selects noise measurements with 3 kHz flat weighting when L/N RL pushbutton is in L/N position. Selects singing return loss low band when L/N RL pushbutton is in RL position.	 "
30	Selects noise measurements with 15 kHz flat weighting when L/N RL pushbutton is in L/N position. Selects external oscillator (if connected at rear panel) for structural return loss measurements, with L/N RL pushbutton at RL.	 "
31	Selects 1010 Hz notch filter for noise measurements when L/N RL pushbutton is in L/N position. Selects either 0/0 or -16/+7 test level point for 4-wire return loss measurements when L/N RL pushbutton in RL position, and CIRCUIT TYPE 4W 600 is pressed.	 "
32	Selects either noise (out position) or noise to ground (in position), measurements when L/N RL pushbutton is in L/N position. Selects either internal compromise network (600 or 900 ohms + 2.16 uF) (out position), or external network if connected at rear panel (in position) for 2-wire return loss measurements with L/N RL pushbutton in RL position.	"
33	Selects 0.2 to 5 kHz bandpass filter for level/noise or return loss measurements.	
34	Selects level/noise or return loss function for switches 23 through 33 described above.	Model 100R-4 only

PROCEDURE 4-1.
SENDING A FIXED TEST TONE AND FREQUENCY OVER AN ACCESSED CIRCUIT.



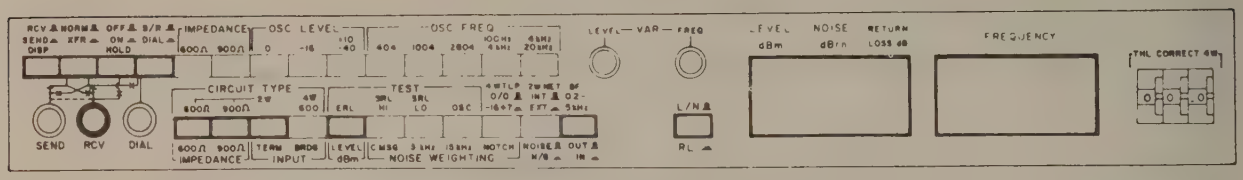
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to send a test tone over an accessed circuit.
2	On Models 100R-4 and 100R-5 only, set the front end pushbuttons as follows: **RCV/SEND/DISP** to **SEND** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only)
3	On Models 100R-4, 100R-5 and 100R-2W, set the pushbuttons for the receive side as follows: **IMPEDANCE** (receive circuits) to **600** or **900** ohms as desired **INPUT TERM** **dBm LEVEL**
4	On Models 100R-4 and 100R-5 only, press the oscillator **IMPEDANCE 600** or **900** ohm pushbutton as required. **NOTE** On the Model 100R-2W, this is a toggle switch selection setting.
5	Press the desired **OSC LEVEL** pushbutton, **0, -2** (Model 100R-2W only), or **-16.**
6	Press the desired **OSC FREQ** pushbutton, **404, 1004,** or **2804.**
7	Access the circuit and connect either through the **SEND** jack on the TTS front panel, or through optional hardwired connections going to the rear of the unit.
8	A tone is now being sent out of the **SEND** jack over the accessed circuit. For Models 100R-4 and 100R-5 the tone level and frequency are displayed on the front panel. **NOTE** For the Model 100R-2W only, press and hold the **CAL** pushbutton to observe the tone level and frequency reading. Release the pushbutton to send tone over the accessed circuit.

PROCEDURE 4-2.
SENDING A VARIABLE TEST TONE AND FREQUENCY OF AN ACCESSED CIRCUIT.



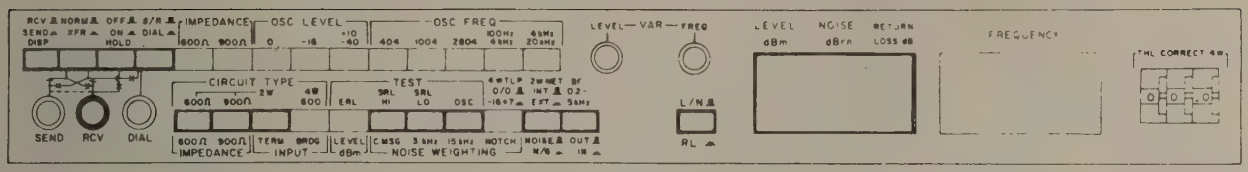
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to send a variable level test tone and frequency over an accessed circuit.
2	On Models 100R-4 and 100R-5, set the front end pushbuttons as follows: **RCV/SEND/DISP** to **SEND** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only).
3	On Models 100R-4, 100R-5 and 100R-2W, set the pushbuttons for the receive side as follows: **IMPEDANCE** (receive circuits) to **600** or **900** ohms as required **INPUT TERM** **dBm LEVEL**
4	On Models 100R-4 and 100R-5 only, press the oscillator **IMPEDANCE 600** or **900** ohm pushbutton as required. On Model 100R-2W, this is a toggle switch selection setting.
5	Press the **OSC LEVEL VAR** pushbutton.
6	Note the reading on the front panel level display. Using the **VAR LEVEL** control, adjust for the desired test tone level. **NOTE** On the Model 100R-2W, press and hold the **CAL** pushbutton to observe the tone level. Release the pushbutton to send tone over the accessed circuit.
7	Press one of the **OSC FREQ VAR** pushbuttons for either a 100 Hz to 4 kHz range or a 4 kHz to 20 kHz range, as required. This is a toggle switch selection for Model 100R-2W.
8	Note the reading on the frequency display. Using the **VAR FREQ** control, adjust for the desired test tone frequency. **NOTE** On the Model 100R-2W, press and hold the **CAL** pushbutton to observe the tone frequency. Release the pushbutton to send tone over the accessed circuit.
9	Access the circuit and connect either through the **SEND** jack on the TTS front panel, or through optional hardwired connections going to the rear of the unit. A tone at the selected level and frequency is now being sent out of the **SEND** jack over the accessed circuit.

PROCEDURE 4-3.
RECEIVING A TEST TONE AND FREQUENCY OVER AN ACCESSED CIRCUIT.



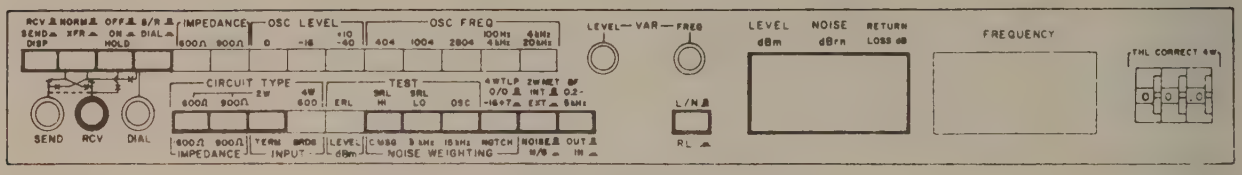
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to receive a test tone and frequency over an accessed circuit.
2	On the Models 100R-4 and 100R-5 only, set the front end pushbuttons as follows: **RCV/SEND/DISP** to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only)
3	On Models 100R-4, 100R-5, and 100R-2W, set the pushbuttons for the receive side as follows: **IMPEDANCE** (receive circuits) to **600** or **900** ohms, as desired **INPUT TERM** **dBm LEVEL**
4	Access the circuit and connect through the **RCV** jack on the TTS front panel, or through optional hardwired connections going to the rear of the unit. **NOTE** If the circuit needs to be accessed using the front panel switching arrangement to provide dialing and holding, refer to procedure 4-9 on page 4-12.
5	The test tone level and frequency should be observed on the front panel displays.

PROCEDURE 4-4.
NOISE MEASUREMENTS OVER AN ACCESSED CIRCUIT.



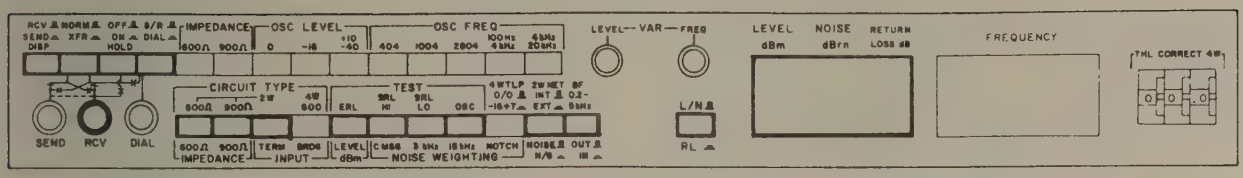
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to measure noise over an accessed circuit.
2	On Models 100R-4 and 100R-5 only, set the front end pushbuttons as follows: **RCV/SEND/DISP** to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only)
3	On Models 100R-4, 100R-5, and 100R-2W, set the pushbuttons for the receive side as follows: **IMPEDANCE** (receive circuits) to **600** or **900** ohms, as desired **INPUT TERM**
4	Set the **NOISE N/G** pushbutton to the **NOISE** position.
5	Select the desired **NOISE WEIGHTING** pushbutton (either **C MSG, 3 kHz, or 15 kHz).**
6	Access the circuit and connect through the **RCV** jack on the TTS front panel, or through optional hardwired connections made at the rear panel. **NOTE** If the circuit needs to be accessed using the front panel switching arrangement to provide dialing and holding, refer to procedure 4-9 on page 4-12.
7	The noise reading in dBrn of the accessed circuit should now be displayed on the front panel readout.

PROCEDURE 4-5.
NOTCHED NOISE MEASUREMENTS OVER AN ACCESSED CIRCUIT.



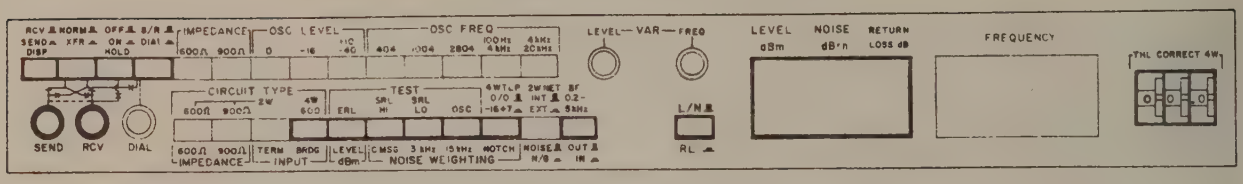
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to measure notched noise over an accessed circuit. A holding tone applied at the far end is notched out at the near end to achieve a dynamic noise measurement.
2	On Models 100R-4 and 100R-5 only, set the front end pushbuttons as follows: **RCV/SEND/DISP** to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only)
3	On Models 100R-4, 100R-5, and 100R-2W, set the pushbuttons for the receive side as follows; **IMPEDANCE** (receive circuits) to **600** or **900** ohms, as desired **INPUT TERM**
4	Set the **NOISE N/G** to the **NOISE** position.
5	Press the **NOISE WEIGHTING NOTCH** pushbutton. (position).
6	Select the desired **NOISE WEIGHTING** pushbutton (either **C MSG, 3 kHz,** or **15 kHz).**
7	Access the circuit and connect through the **RCV** jack on the TTS front panel, or through optional hardwired connections made at the rear panel. **NOTE** If the circuit needs to be accessed using the front panel switching arrangement to provide dialing and holding, refer to procedure 4-9 on page 4-12.
8	The notched noise reading in dBrn of the accessed circuit should now be displayed on the front panel readout.

PROCEDURE 4-6.
NOISE-TO-GROUND MEASUREMENTS ON METALLIC CIRCUITS
(MODELS 100R-4, 100R-5 ONLY).



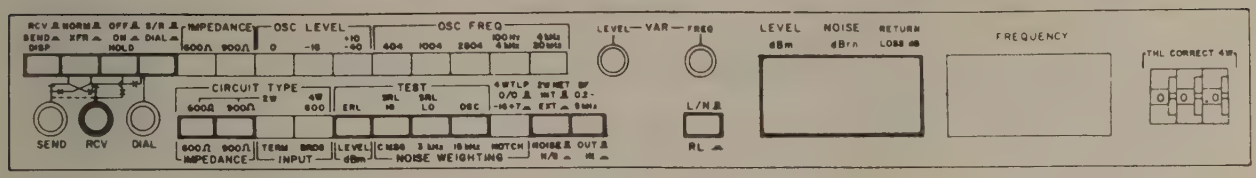
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to measure noise to ground over an accessed metallic circuit. **NOTE** It is necessary to check first that the fuse panel or office ground is provided on pin 8 of rear panel connector TS-1. Refer to Note 2 on the CAD drawings on pages 7-5 through 7-7. This provides the ground reference necessary for the noise-to-ground measuring circuits.
2	Set the front end pushbuttons as follows: **RCV/SEND/DISP** to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **BP 0.2-5 kHz** to **OUT** **L/N RL** to **L/N** (Model 100R-4 only)
3	Set the pushbuttons for the receive side as follows: **IMPEDANCE** (receive circuits) to **600** or **900** ohms, as desired **INPUT TERM**
4	Set the **NOISE N/G** pushbutton to the **N/G** position.
5	Set the **NOISE WEIGHTING NOTCH** pushbutton to the in or out position as required for the test being made.
6	Select the desired NOISE WEIGHTING pushbutton (either **C MSG, 3 kHz, or 15 kHz**).
7	Access the TTS through the RCV jack on the front panel, or through optional hardwired connections made at the rear panel. Connect the T and R wires together, then connect them to the circuit under test.
8	The noise-to-ground reading in dBrn of the accessed circuit should now be shown on the front panel display.

PROCEDURE 4-7.
4—WIRE TRANSHYBRID BALANCE (RETURN LOSS) MEASUREMENTS, MODELS 100R-4, 100R-6 ONLY.



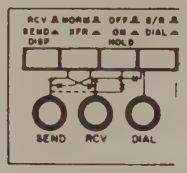
STEP	PROCEDURE
1	This procedure is used to set the TTS controls to make a local 4-wire transhybrid balance measurement, a 4-wire through measurement, or a terminal balance measurement to a distant office.
2	On Models 100R-4 and 100R-6 only, set the pushbuttons as follows: **RCV/SEND/DISP** (Model 100R-4 only) to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **CIRCUIT TYPE** to **4W 600** ohms **TEST** to **ERL, SRL HI,** or **SRL LO**, depending on type of test being made **4WTLP** to **0/0** **BP 0.2-5 kHz** to **IN** position **L/N RL** (Model 100R-4 only) to **RL**
3	Using a standard Type 310 patchcord, connect to the 4-wire receive and transmit portion of the circuit under test by connecting the TTS **SEND** jack to the circuit receive side, and the TTS **RCV** jack to the circuit send side.
4	Place a short or an open on the 2-wire portion of the circuit under test.
5	Adjust the **THL CORRECT 4W** thumbwheels until the front panel display reads **0 dB.** The thumbwheel settings should be somewhere between 23.0 and 29.9 for the 0 dB display.
6	Remove the short or open from the 2-wire circuit side (made in step 4).
7	Observe the reading on the front panel display. This is the ERL or SRL of the circuit under test, depending on which **TEST** pushbutton was selected in step 2.
8	When making a 4-wire measurement over a carrier facility (-16/+7 TLP), proceed with steps 9 through 12.
9	Set the **4WTLP 0/0 -16/+7 pushbutton to -16/+7**
10	Connect the **SEND** jack of the TTS to the "MOD IN" of the carrier channel under test (-16 TLP). Connect the **RCV** jack of the TTS to the "DEMOD OUT" of the circuit under test (+7 TLP).
11	Repeat steps 4 through 7, except the far end places the short or open on the 2-wire end of the circuit under test.
12	Remove all patchcords and restore the circuit to normal.

PROCEDURE 4-8.
2-WIRE ERL AND SRL MEASUREMENTS (MODELS 100R-4, 100R-6 ONLY).



STEP	PROCEDURE
1	This procedure is used to set the TTS controls to make a 2-wire circuit return loss measurement.
2	On the Model 100R-4 or 100R-6, set the pushbuttons as follows: **RCV/SEND/DISP** (Model 100R-4 only) to **RCV** **NORM/XFR** to **NORM** **OFF/ON/DIAL** to **OFF** **S/R DIAL** to **S/R** **CIRCUIT TYPE** to **600** or **900 2W** as required for circuit **TEST** to **ERL**, **SRL HI**, or **SRL LO**, depending on test type being made **4WTLP** to **0/0** **2W NET** to **INT**, or **EXT** (optional if using external compromise network (600 or 900 ohms + 2.16 uF connected to rear panel connector TS-1, pins C and D. See CAD drawings in Section 7). **BP 0.2-5 kHz** to **IN** **L/N RL** (Model 100R-4 only) to **RL**
3	The front panel return loss display should read 0 dB. If not, adjust control LEVEL 1 on the rear panel (see procedure 3-2 in Section 3, page 3-2).
4	Connect the **SEND** jack of the TTS to the 2-wire transmission point of the circuit to be measured.
5	The return loss display reading is the actual ERL or SRL (as selected in step 2) in dB of the circuit under test.
6	Remove all patchcords and restore the circuit to normal.

PROCEDURE 4-9.
TRANSMISSION TESTING ON 2-WIRE CIRCUITS
(MODELS 100R-4, 100R-5, 100R-6 ONLY).



STEP	PROCEDURE
1	This procedure outlines the use of the switches to dial up, talk over, and send/receive on 2-wire facilities.
2	Connect the 2-wire facility to the TTS front panel **RCV** jack.
3	Set the pushbuttons as follows: **RCV/SEND/DISP** to **RCV** (100R-4 & 100R-5 only) **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **DIAL**
4	Patch the test board position circuit or dial set to the **DIAL** jack for talking and dialing.
5	Establish the 2-wire connection as required.
6	To send or receive tone, set up the TTS oscillator and receive pushbuttons as per procedures 4-1 through 4-3 in this section.
7	To receive a tone on the circuit, set the **OFF/ON/HOLD** pushbutton to **ON** and the **S/R DIAL** pushbutton to **S/R** .
8	Observe the TTS level and frequency displays for the received tone.
	Models 100R-4 & 100R-5 only
9	To send a tone over the same circuit, set the **NORM/XFR** pushbutton to **XFR** .
10	To observe the actual level and frequency of the tone being sent to the far end, set the **RCV/SEND/DISP** pushbutton to **SEND** .

SECTION 5
FUNCTIONAL DESCRIPTION

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   C. Return Loss Transmitter (Models 100R-4, 100R-6).....5-1
   D. Receiver Analog Circuits 5-2
   E. Digital Signal Processing Circuits 5-3
   F. Switching and Control Logic Circuits 5-3

5.0 CIRCUIT DESCRIPTIONS

A. General

5.01 This section provides a block diagram level description of the circuit operation, which is arranged as follows:

(a) Transmitter circuits, Level/Noise and Return Loss (reference Figure 5-1).

(b) Receiver analog circuits, Level/Noise, Frequency, Return Loss (reference Figure 5-2).

(c) Digital signalling processing circuits (reference Figure 5-3).

(d) Switching and control logic circuits (reference Figure 5-4).

B. Transmitter Circuits for Oscillator and Return Loss

5.02 The send oscillator signal is generated by U306, the output of which is a near-pure sine wave with a high frequency stability. The frequency output is set by front panel VAR FREQ control R2, or at one of three fixed frequencies by pushbuttons 404, 1004, or 2804 (S22 through S24). U307 provides automatic level control to ensure a uniform output level throughout the operating frequency range of U306.

5.03 U308 provides for setting the oscillator output level through R1, the front panel VAR LEVEL control or OSC LEVEL pushbuttons 0 or -16 (S19 or S20). On the Model 100R-2W, a third pushbutton for -2 dBm is provided.

5.04 When the 1004 OSC FREQ pushbutton is selected, low pass filter U309 is inserted to ensure that second and third order harmonics are reduced below the 0.5% specification. Output amplifier U310 provides the correct gain and impedance for either the 600 ohm or 900 ohm output selected and fed through L/N RL switch S12 and balanced transformer T300 to the front panel SEND jack, J1. The oscillator tip spring and ring spring contacts are also accessible at rear panel wirewrap connections.

C. Return Loss Transmitter (Models 100R-4 and 100R-6 only)

5.05 The return loss transmitter signal is white noise with a uniform quality and amplitude that is digitally synthesized by U300 and U301. The output is fed to three bandpass filters, for the ERL, SRL LO, and SRL HI test types (U302 through U305). The output of the three filters in turn is fed to analog multiplexer U312. The test type output of U312 is determined by the binary levels on logic control lines S and R as follows:

S	R	TEST TYPE
0	0	ERL
0	1	SRL HI
1	0	SRL LO
1	1	EXT.Osc.

where 0 = approx. 0 to 0.8 VDC 1 = approx. +4 to +5 VDC

5.06 The output of U312 is applied to output amplifier U311 when the front panel 4WTLP switch (S9) is in the 0/0 position. When in the -16+7 position, the transmit output level is -2 dBm, and a 16 dB pad is inserted to reduce the output of U311 to -18 dBm. This is also referred to as a -16 test level point used for 4-wire return loss measurements on carrier channels. The 0/0 -16/+7 TLP switch is automatically disabled when in the 2-wire mode.

5.07 The output of return loss output amplifier U311 is fed through L/N RL switch S12 (when pressed in) to transformer T300 and on to the SEND Jack, J1. S12 also switches in the precision bridging network required for return loss measurements.

5.08 The outputs of oscillator output amplifier U310 and return loss output amplifier U311 are also applied to multiplexer U313. When the binary control input P to U313 is a 0, the oscillator signal is sent to the receiver circuits to read the level and frequency on the front panel displays if the RCV SEND DISP switch, S13 is pressed). When the control signal at P is a 1, the return loss transmit signal is sent to the level display for viewing.

D. Receiver Analog Circuits

5.09 The receiver analog circuits process the input signals for level, noise, and frequency readings. For Models 100R-4 and 100R-6, they also provide processing for return loss readings.

5.10 Refer to Figure 5-2. The signal to be measured is fed from the input switching circuits (described in the last portion of this section) to balanced input transformer T100 for minimum noise pickup. A blocking capacitor provides input circuit protection up to 300 VDC. The 600 or 900 ohm input is applied to multiplexer U1 along with the CAL SEND input from the transmitter circuits and the noise-to-ground signal. When noise-to-ground is being measured, the signal is passed through a resistive 40 dB attenuator to reduce it to a level suitable for the following circuits. The NOISE N/G pushbutton S10 selects this measurement. U1 selects one of these four signals by binary control signals at points A and B as follows:

A	B	FUNCTION
0	0	CAL SEND
0	1	900 ohm
1	0	600 ohm
1	1	Noise-to-ground

5.11 The output of U1 is fed through buffer U2 to either the 1010 Hz noise notch filter (U6 through U9) or to autoranging amplifier circuit, U3 and U4. If NOTCH pushbutton S9 is selected, transistor switch Q9 feeds the notch filter output signal to the autoranging circuit directly.

Similarly, for any other signal, transistor switch Q8 routes buffer U2 output to autoranging circuit U3 and U4. The autoranging circuit consists of U3 (10 dB gain amplifier), the two dividers and multiplexer U4 that is controlled by the microprocessor in the digital portion through binary control points E, F, G and H. This action provides a 15 dB dynamic range (10 dB plus 5 dB hysteresis). The binary control is as follows:

E	F	G	H	RANGE
0	1	1	1	HIGHEST
0	1	1	0	"
0	1	0	1	"
0	1	0	0	"
0	0	1	1	"
0	0	1	0	"
0	0	0	1	"
0	0	0	0	"
1	0	0	0	LOWEST

5.12 The output of the autoranging circuits is passed through a 19 dB amplifier, U5, which makes up for some of the signal losses in the preceeding resistive divider network. For noise measurements, the output of U5 is applied through amplifier U10 to one of three noise weighting filters for C message, 3 kHz flat, or 15 kHz flat to multiplexer U14, depending which front panel pushbutton is pressed (S6, S7, S8). For level and frequency measurements, the output of U5 is fed directly to U14. For level or return loss measurements, bandpass filter U12 may be switched in (using pushbutton S11) to prevent high or low frequencies outside the band of interest from affecting the readings. Also, for 4-wire return loss measurements at a -16/+7 test level point, a 7 dB pad is inserted in amplifier U13 when push-button S9 is pressed.

5.13 Multiplexer U14 selects either level/frequency, noise, or return loss through binary control signals at points K and L as follows:

K	L	FUNCTION
0	0	Level/frequency
0	1	4-wire return loss
1	0	2-wire return loss
1	1	Noise

5.14 One output from U14 is applied to amplifier U15 and U314 to drive the front panel audio monitor speaker (Model 100R-5 only) and the audio monitor output at the rear panel wirewrap connector (all models). A second output of U14 is fed to sinewave-to-squarewave converter U18,Q13 to provide an input to the digital frequency measuring circuits described later. The third output from U14 is fed to an average detector for level measurements, then applied to log converter U18 and U19. For noise and return loss measurements, the signal is fed to both the average and peak detectors to obtain the correct quasi-rms response. This is controlled by the decoder logic through U20, Q14. Log converters U18 and U19 produce a squarewave output that has a time duration proportional to the logarithmic value of the measured signal. This output is applied to the digital circuits, described next.

E. Digital Signal Processing Circuits

5.15 The output from U18, Q13 is applied to a times 10 frequency counter, U21, U22, U23, and to U24, which contains three separate binary counters. Also fed to U24 is the frequency times 10 output and the output of U42, which senses whether the signal being measured is in range, underrange or overrange. The clock output of timer U31, U40, fed through U42, controls when the 3 counters in U24 are reset in order to provide the correct reading update rate. The output of the U24 counters is applied to a microprocessor (U25, U26, U27). The microprocessor senses the hysteresis points in up and down ranging and provides the appropriate resolution for the frequency measurements for the range in use. In addition, the microprocessor supplies binary control signals to the transmitter and analog circuits, plus the measured signal value in BCD format to display controllers U33, U34. U33 and U34 provide BCD to 7-segment conversion for the digital readouts. The measured signal value is also supplied in serial format through buffer U41 for a 2-wire output to remote displays.

5.16 Microprocessor U25, U26, U27 provides binary control signals through U32 to control multiplexer U4 in the analog circuits. Also, the microprocessor supplies and receives control information through multiplexer U28, U29, U30. The 4 station-identification control lines provide a test position number on the remote display to show which TTS has been selected by the optional 2-wire combiner (Model 100C-2W). The binary levels of the four lines are set by strapping on rear panel connector, TS1.

5.17 The frequency inhibit input to U28, U29, U30 is a binary 0 for noise measurements to turn off the frequency display. For other measurement functions, the level is a binary 1.

5.18 The three THL control lines provide binary levels as follows for transhybrid loss correction on 4-wire return loss measurements: Maximum setting is 29.9 dB.

LOSS	10dB	1dB	0.1dB
0	0	0	1
1.0	0	1	0
10.0	1	0	0

5.19 The four test-mode control lines, B0 through B3 in Figure 5-4, are applied to U28, U29, U30 to tell the microprocessor which measurement function is selected. The binary level control is as follows:

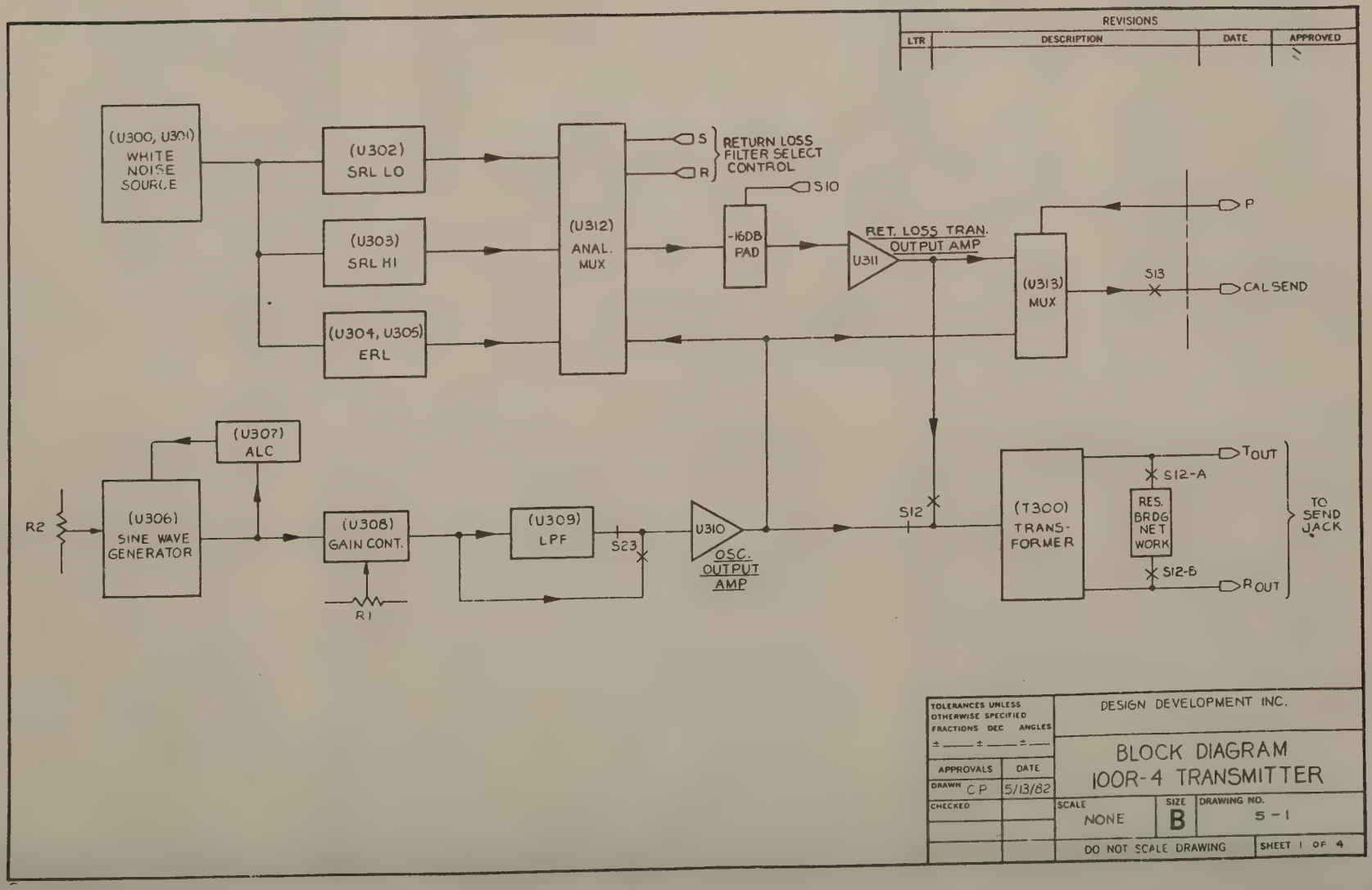
FUNCTION	B0	B1	B2	B3
Level	0	0	0	0
Noise	0	0	0	1
N/G	0	1	0	1
Ret. Loss	0	0	1	0

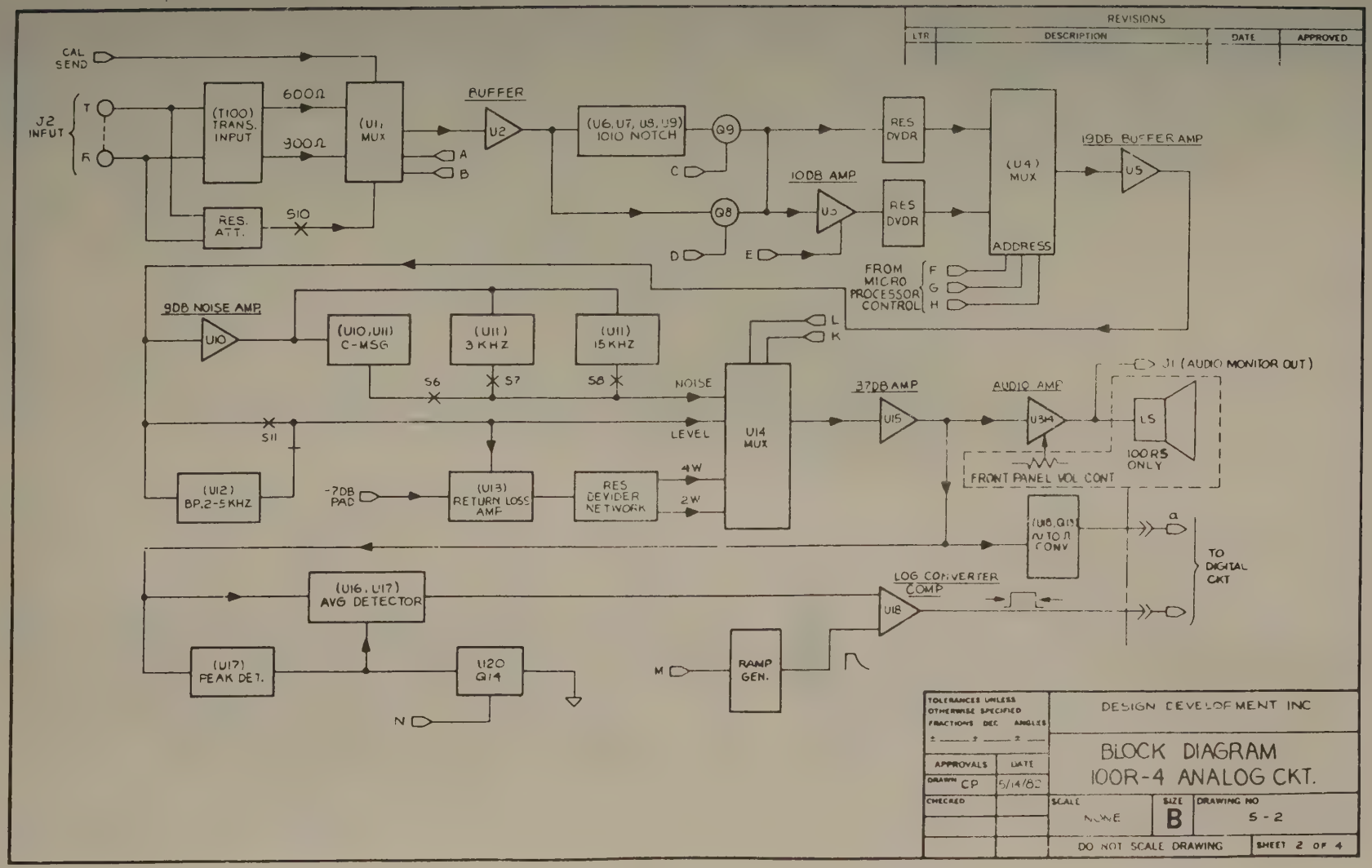
F. Switching and Control Logic Circuits

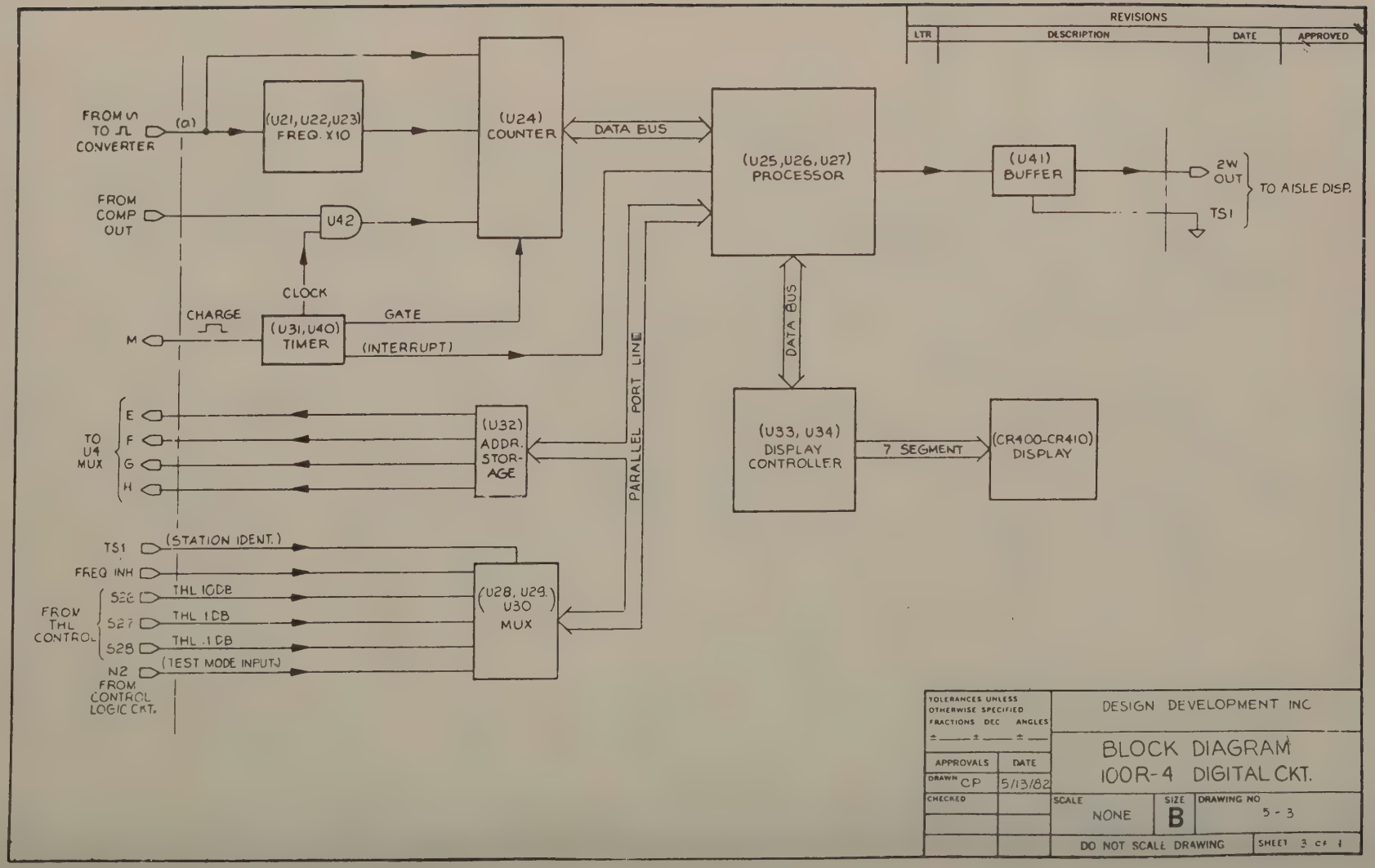
5.20 Refer to Figure 5-4. The SEND and RCV jacks connect to the transmit and receive circuits through front-end switching. Hold circuits can be switched in by pushbutton S15 to provide holding when making measurements on a 2-wire circuit such as a balanced termination number (Code 100).

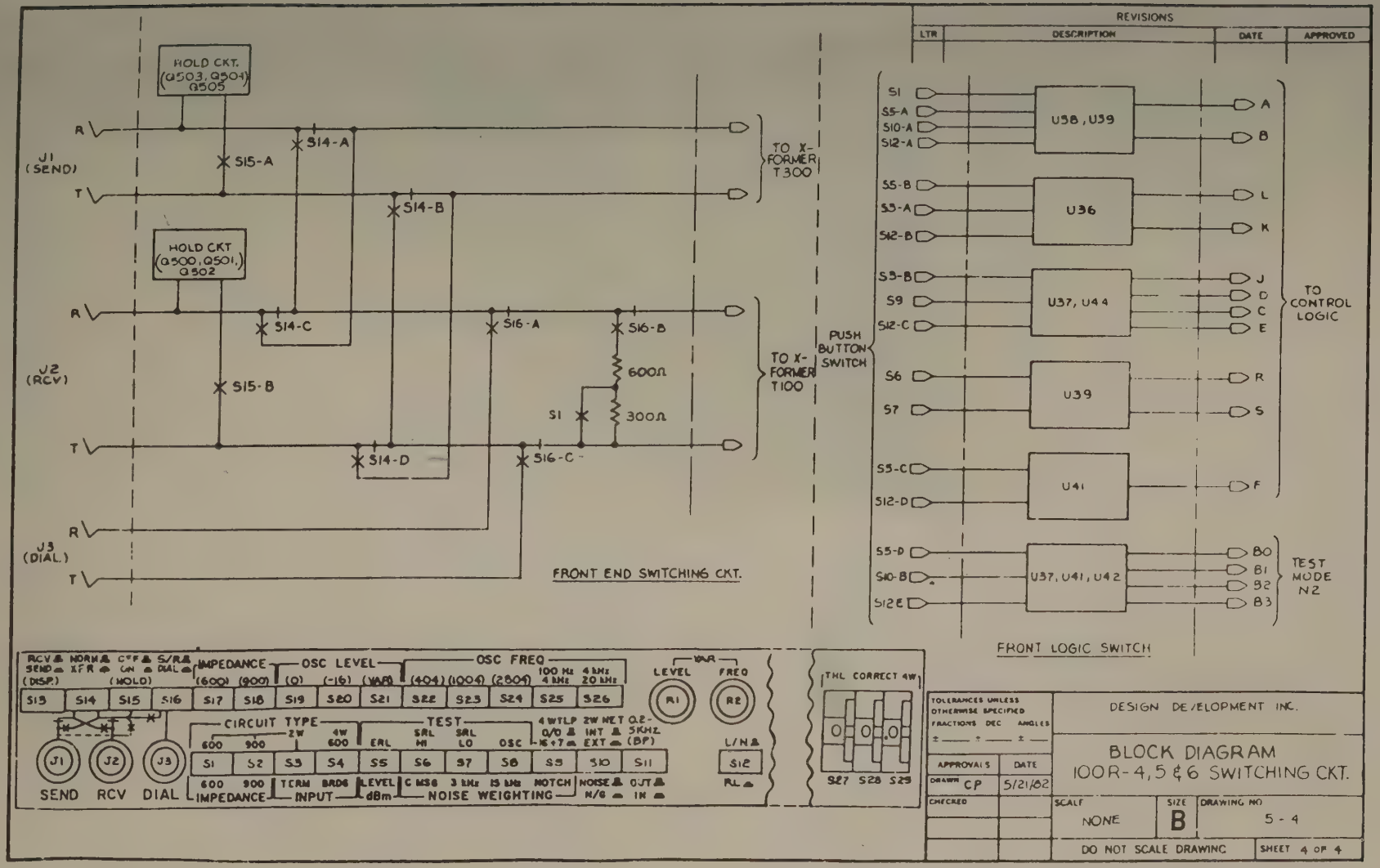
Dial jack J3 is used to plug in a handset to dial up and hold a circuit. When the test is completed in one direction, switch S14 (NORM XFR) is pressed to reverse the transmit/receive direction without reverse plugging the handset. Impedance selection of 600 or 900 ohms is provided by pushbutton S1.

5.21 The front logic switching consists of flip-flops that receive contact closures from the front panel pushbutton switches in various combinations. The flip-flops provide binary control signals for the transmit, receive and digital circuits in the test set.


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
(U300, U301) WHITE NOISE SOURCE
(U302) SRL LO
(U303) SRL HI
(U304, U305) ERL
(U312) ANAL. MUX
S
R
RETURN LOSS FILTER SELECT CONTROL
S10
-16DB PAD
U311
RET. LOSS TRAN. OUTPUT AMP
P
(U313) MUX
S13
CALSEND
(U307) ALC
R2
(U306) SINE WAVE GENERATOR
(U308) GAIN CONT.
R1
(U309) LPF
S23
U310
OSC. OUTPUT AMP
S12
(T300) TRANS-FORMER
TOUT
S12-A
RES. BRDG NET WORK
S12-B
ROUT
TO SEND JACK
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
APPROVALS
DATE
DRAWN C P
5/13/82
CHECKED
DESIGN DEVELOPMENT INC.
BLOCK DIAGRAM
100R-4 TRANSMITTER
SCALE NONE
SIZE B
DRAWING NO. 5-1
DO NOT SCALE DRAWING
SHEET 1 OF 4


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
CAL SEND
J2 INPUT
T
R
(T100) TRANS. INPUT
600Ω
900Ω
(U1) MUX
A
B
RES. ATT.
S10
BUFFER
U2
(U6, U7, U8, U9) 1010 NOTCH
Q9
C
Q8
D
E
10DB AMP
U3
RES DVDR
RES DVDR
(U4) MUX
ADDRESS
19DB BUFFER AMP
U5
FROM MICRO PROCESSOR CONTROL
F
G
H
9DB NOISE AMP
U10
(U10, U11) C-MSG
(U11) 3 KHZ
(U11) 15KHZ
L
K
S6
S7
S8
NOISE
LEVEL
S11
(U12) BP.2-5KHZ
-7DB PAD
(U13) RETURN LOSS AMP
RES DEVIDER NETWORK
4W
2W
U14 MUX
37DB AMP
U15
AUDIO AMP
U34
J1 (AUDIO MONITOR OUT)
LS
100R5 ONLY
FRONT PANEL VOL CONT
(U8, Q15) N TO N CONV
a
TO DIGITAL CKT
LOG CONVERTER COMP
U18
(U16, U17) AVG DETECTOR
(U17) PEAK DET.
U20 Q14
M
RAMP GEN.
N
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
APPROVALS
DATE
DRAWN CP
5/14/82
CHECKED
DESIGN DEVELOPMENT INC
BLOCK DIAGRAM
100R-4 ANALOG CKT.
SCALE NONE
SIZE B
DRAWING NO 5-2
DO NOT SCALE DRAWING
SHEET 2 OF 4


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
FROM V TO ∫ CONVERTER
(a)
(U21, U22, U23) FREQ. X10
(U24) COUNTER
DATA BUS
(U25, U26, U27) PROCESSOR
(U41) BUFFER
2W OUT
TS1
TO AISLE DISP.
FROM COMP OUT
U42
CLOCK
CHARGE
M
(U31, U40) TIMER
GATE
(INTERRUPT)
DATA BUS
PARALLEL PORT LINE
TO U4 MUX
E
F
G
H
(U32) ADDR. STOR-AGE
(U33, U34) DISPLAY CONTROLLER
7 SEGMENT
(CR400-CR410) DISPLAY
TS1
(STATION IDENT.)
FREQ INH
FROM THL CONTROL
S26
S27
S28
THL 10DB
THL 1DB
THL .1DB
(TEST MODE INPUT)
N2 FROM CONTROL LOGIC CKT.
(U28, U29, U30) MUX
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
APPROVALS
DATE
DRAWN CP
5/13/82
CHECKED
DESIGN DEVELOPMENT INC
BLOCK DIAGRAM
100R-4 DIGITAL CKT.
SCALE NONE
SIZE B
DRAWING NO 5-3
DO NOT SCALE DRAWING
SHEET 3 OF 4


HOLD CKT. (Q503, Q504) Q505
HOLD CKT (Q500, Q501,) Q502
J1 (SEND)
J2 (RCV)
J3 (DIAL)
R
T
S15-A
S14-A
S14-B
S14-C
S15-B
S14-D
S16-A
S16-B
S16-C
600Ω
300Ω
S1
TO X-FORMER T300
TO X-FORMER T100
FRONT END SWITCHING CKT.
PUSH BUTTON SWITCH
S1
S5-A
S10-A
S12-A
U38, U39
A
B
S5-B
S3-A
S12-B
U36
L
K
S3-B
S9
S12-C
U37, U44
J
D
C
E
TO CONTROL LOGIC
S6
S7
U39
R
S
S5-C
S12-D
U41
F
S5-D
S10-B
S12E
U37, U41, U42
B0
B1
B2
B3
TEST MODE N2
FRONT LOGIC SWITCH
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
RCV NORM OFF S/R
SEND XFR ON DIAL
(DISP.) (HOLD)
IMPEDANCE (600) (900)
OSC LEVEL (0) (-16) (VAR)
OSC FREQ (404) (1004) (2804) 100 Hz 4 kHz 20 kHz
S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25 S26
CIRCUIT TYPE 600 900 2W 4W 600
TEST ERL SRL HI SRL LO OSC
4 W TLP 2W MET 0.2-0/0 INT 3 KHZ NS+T EXT (BP)
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11
600 900 IMPEDANCE TERM INPUT BRDG
LEVEL dBm
C MSG 3 kHz 15 kHz NOISE WEIGHTING
NOTCH
NOISE OUT N/G IN
J1 J2 J3
SEND RCV DIAL
VAR
LEVEL R1
FREQ R2
L/N S12
RL
THL CORRECT 4W
S27 S28 S29
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS DEC ANGLES
± ± ±
APPROVALS DATE
DRAWN CP 5/21/82
CHECKED
DESIGN DEVELOPMENT INC.
BLOCK DIAGRAM
100R-4,5 & 6 SWITCHING CKT.
SCALE NONE
SIZE B
DRAWING NO 5-4
DO NOT SCALE DRAWING
SHEET 4 OF 4

SECTION 6
CALIBRATION PROCEDURES

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6.0 CALIBRATION PROCEDURES

A. Introduction

6.01 The calibration procedures in this section are intended to ensure that the equipment meets the design specifications. These procedures may be performed periodically as per office practice, or when test readings do not agree with those of similar instruments.

CAUTION

The calibration should only be performed if it is suspected that the equipment is truly out of calibration. See Section 3 for routine performance checks.

B. Test Equipment and Skill Required

6.02 The calibration procedures require precision laboratory test equipment as specified in Table 6-1, or other equivalent. The craftsperson performing these procedures should be experienced in using this test equipment and have knowledge of electronic calibration techniques in general.

TABLE 6-1. TEST EQUIPMENT REQUIRED

TYPE	MODEL/MANUFACTURER	USE
Digital Voltmeter	Hewlett Packard 3490A	Monitor input level to TTS.
Signal Generator	Hewlett Packard 3320B	To supply accurate signal level
Precision resistor	600 ohms, 0.1%	To supply accurate termination
Precision resistor	900 ohms, 0.1%	To supply accurate termination

PROCEDURE 6-1.
LEVEL CALIBRATION PROCEDURE

STEP	PROCEDURE
1	Locate the three 10-turn potentiometers on the rear of the TTS marked A, B, and C. These are accessable by removing the cover plate over TS1.
2	Set up the test equipment as shown in Figure 6-1, sketch A. Set the signal generator for a 1 kHz output and set the level so that the voltmeter reads 0.774596 volts.
3	Connect the signal generator to the **RCV** jack on the TTS as shown in sketch B. **CAUTION** Be careful not to disturb the signal generator settings established in step 2.
4	On the Model 100R-4 and 100R-5 only, set the front panel pushbuttons as follows: **RCV/SEND/DISP** to **RCV** **NORM/XFR** to **NORM** **OFF/ON/HOLD** to **OFF** **S/R DIAL** to **S/R** **L/N RL** to **L/N** (Model 100R-4 only)
5	Select the **IMPEDANCE 600, INPUT TERM,** and **dBm LEVEL** pushbuttons. Check that the level display reads 0.0 dBm. If not, adjust potentiometer A.
6	Set up the equipment as per sketch C. Set the signal generator for 1 kHz output and adjust the level so that the voltmeter reads 0.948683 volts.
7	Connect the signal generator to the TTS as per sketch D. Be careful not to disturb the signal generator settings.
8	Select the **IMPEDANCE 900** ohm pushbutton. Check that the level display reads 0.0. If not, adjust potentiometer C.
9	This completes calibration of the 600 and 900 ohm receiver input circuits.

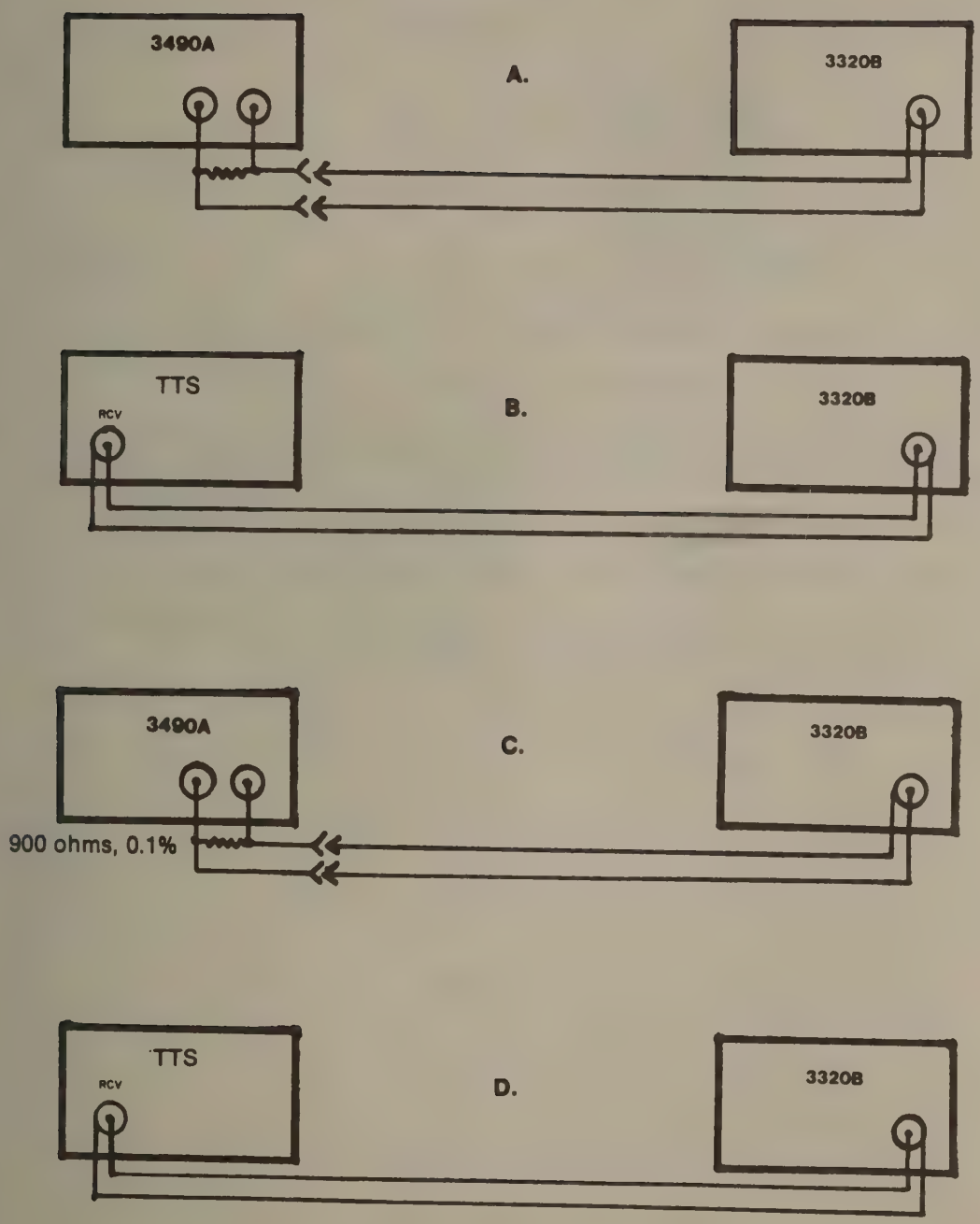

FIGURE 6-1. CALIBRATION TEST SETUP DIAGRAMS

PROCEDURE 6-2.
NOISE CALIBRATION PROCEDURE.

STEP	PROCEDURE
	NOTE The level calibration procedure must be performed before starting this procedure.
1	Patch from the **SEND** jack to the **RCV** jack using a standard Type 310 patch cord. Set the pushbuttons as follows: **OSC LEVEL** to **VAR** $^{+10}_{-40}$ **OSC FREQ** to **1004** **NOTCH** button OUT
2	Select the **IMPEDANCE 600, INPUT TERM** and **LEVEL dBm** pushbuttons.
3	Set the **VAR LEVEL** control for a reading of **-39.6 dB** on the level display.
4	Press the **NOISE WEIGHTING 3 kHz** pushbutton. Check that the display reads +50 dBrn. If not, adjust potentiometer B until the display just changes from +51 to +50 dBrn.
5	Press the **LEVEL dBm** pushbutton. Set the **VAR LEVEL** control for a reading of -40.0 dBm.
6	Press the **NOISE WEIGHTING 3 kHz** pushbutton. Check that the display reads +50 dBrn.
7	Check that the 900 ohm impedance gives the same results, when the oscillator output and the TTS receiver input pushbuttons are selected for 900 ohms.
8	This completes calibration of the noise receiver.

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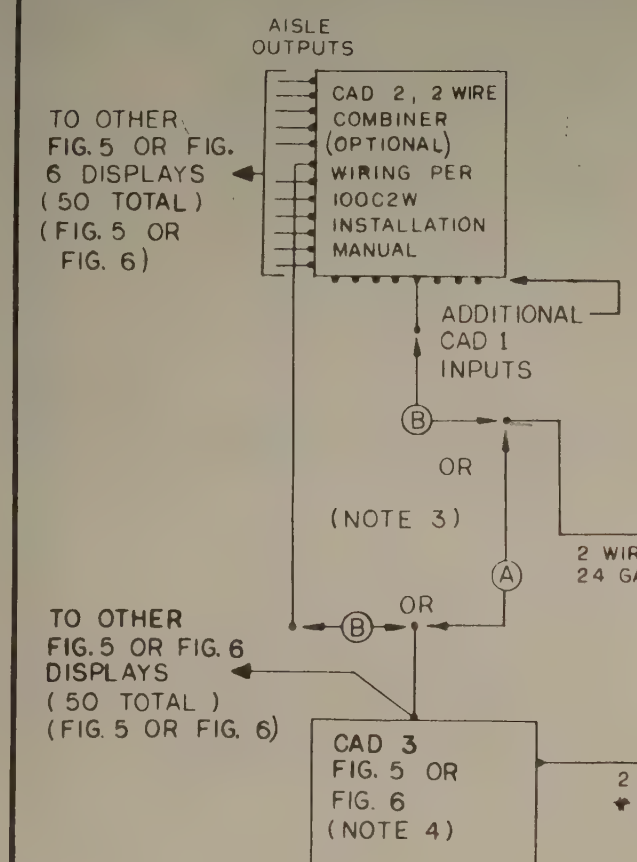
CABLE APPARATUS DRAWING - OVERALL SYSTEM	2	X								
TRANSMISSION TEST SET MODEL 100R2W CAD 1 FIG. 1	3		X							
ERL AND TRANSMISSION TEST MODEL 100R4 CAD 1 FIG. 2	4	X								
TRANSMISSION TEST SET MODEL 100R5 CAD 1 FIG. 3	5	X								
ERL MEASURING SET MODEL 100R6 CAD 1 FIG. 4	6	X								
CABLING 100A2W TO 100R2W/100R5 CAD 3 FIG. 5	7	X								
CABLING 100A3 TO 100R4/100R5/100R6 CAD 3 FIG. 6	8	X								
POWER WIRING CAD 4 FIG. 7	9	X								
MODEL 100R2W OUTLINE DRAWING	10		X							
MODEL 100R4 OUTLINE DRAWING	11	X								
MODEL 100R5 OUTLINE DRAWING	12	X								
MODEL 100R6 OUTLINE DRAWING	13	X								
MODEL 100A2W OUTLINE DRAWING	14		X							
MODEL 100A3 OUTLINE DRAWING	15	X								
MODEL 100AB 1 OUTLINE DRAWING	15A	X								
MODEL 100AB 3 OUTLINE DRAWING	15B	X								

		DESIGN DEVELOPMENT INC.	
		INSTALLERS DRAWINGS FOR MODELS 100R2W, 100R4, 100R5 100R6, 100A2W AND 100A3	
APPROVAL	DATE		
DRAWN TWB	3/25/82		
CHECKED		SCALE NONE	SIZE A
ISSUE	1		SHEET 1 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED


AISLE OUTPUTS
CAD 2, 2 WIRE COMBINER (OPTIONAL) WIRING PER 100C2W INSTALLATION MANUAL
TO OTHER FIG. 5 OR FIG. 6 DISPLAYS (50 TOTAL) (FIG. 5 OR FIG. 6)
ADDITIONAL CAD 1 INPUTS
B
OR
(NOTE 3)
A
OR
B
TO OTHER FIG. 5 OR FIG. 6 DISPLAYS (50 TOTAL) (FIG. 5 OR FIG. 6)
CAD 3 FIG. 5 OR FIG. 6 (NOTE 4)
2 WIRES #16 OR #18 GA COPPER
2 WIRES (1 PAIR) 24 GA UNSHIELDED
CAD 1 FIG. 1, FIG. 2 OR FIG. 3
4 WIRES #16 OR #18 GA COPPER
CAD 4 INPUT POWER
FUSE PANEL OFFICE -48VDC
PANEL GROUND

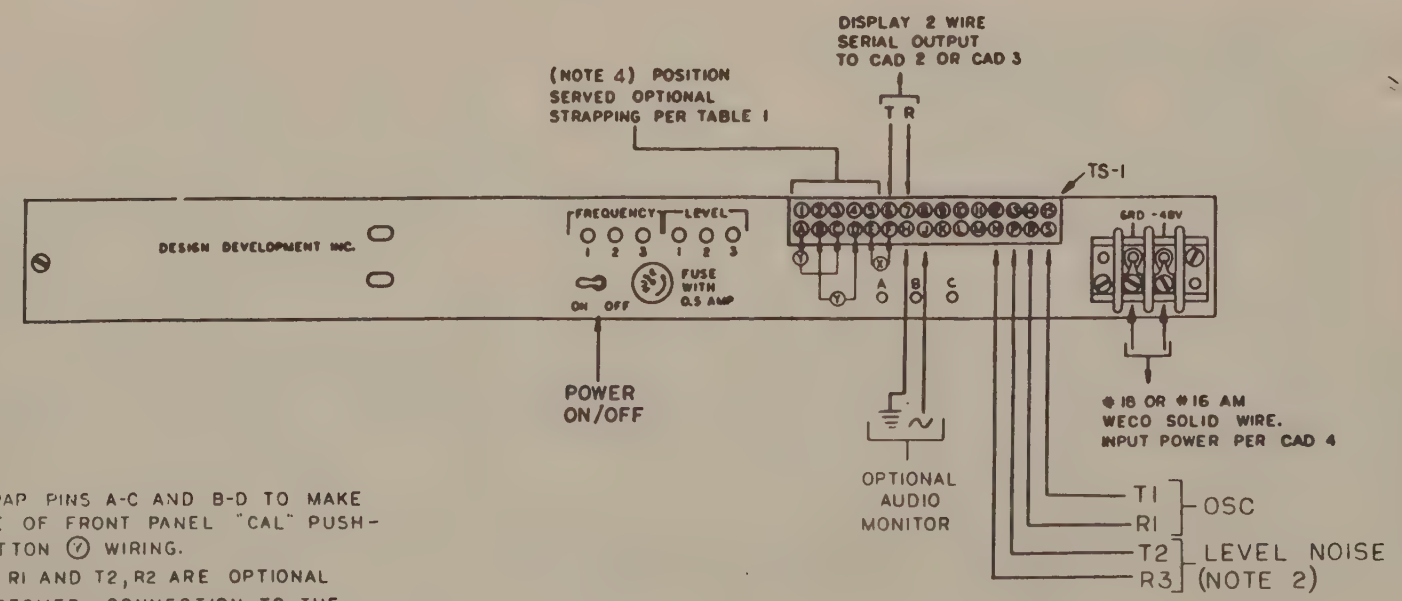
NOTES:

1. CABLING CAD 1-2-3 NOT TO EXCEED 10,000 FEET ANY SINGLE OR COMBINED MULTIPLE RUNS.
2. NOT MORE THAN 50 TOTAL FIG. 5 OR FIG. 6 UNITS PER INSTALLATION.
3. USE (A) WIRING WHEN CAD 2 IS NOT PROVIDED, (B) WIRING WHEN 100C-2W IS PROVIDED.
4. USE 100A3 AISLE DISPLAY WITH MODEL 100R4, 100R2W OR 100R5 MAY BE USED WITH EITHER 100A2W OR 100A3 AISLE DISPLAYS.

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	CABLE APPARATUS DWING. OVERALL SYSTEM	
DRAWN TWB	12/15/81		
CHECKED		SCALE NONE	SIZE B
PEG	12/17-81	DRAWING NO.	
ISSUE	1	DO NOT SCALE DRAWING	SHEET 2 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

CAD 1
FIGURE 1



NOTES:

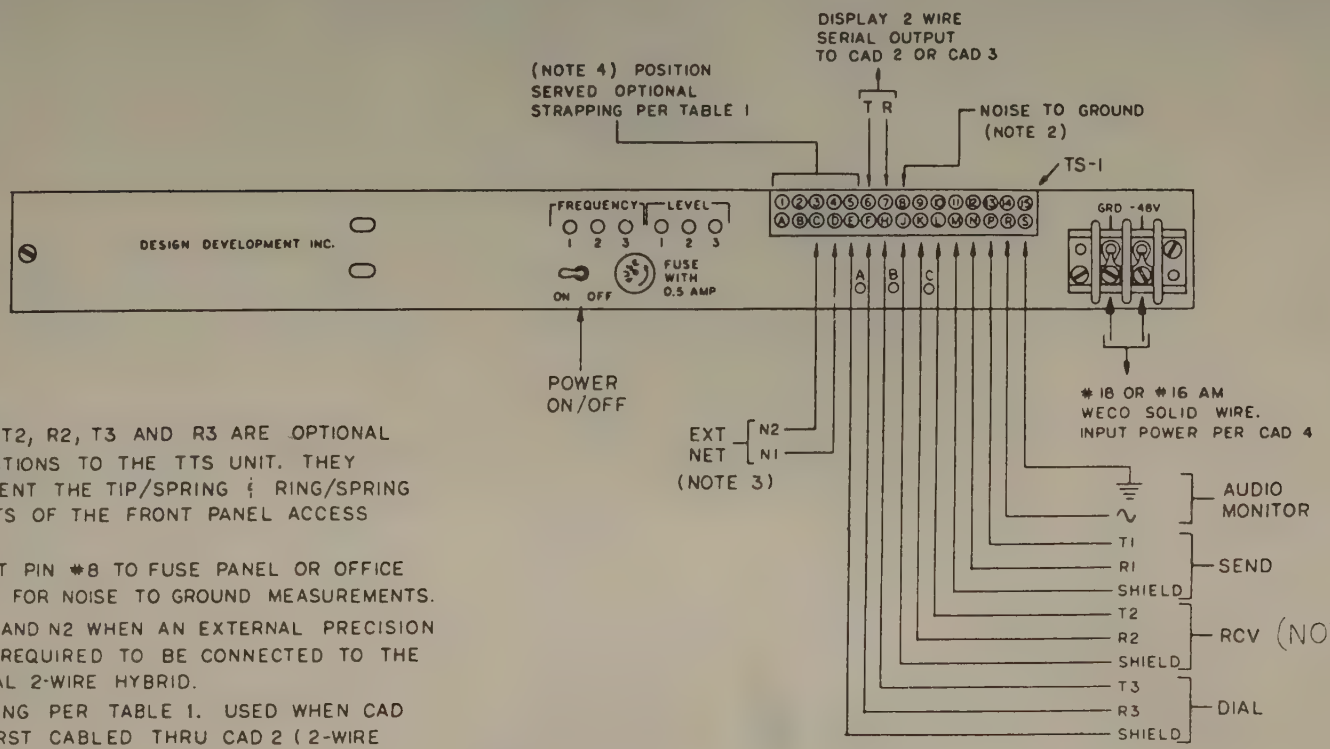
1. STRAP PINS A-C AND B-D TO MAKE USE OF FRONT PANEL "CAL" PUSH-BUTTON (Y) WIRING.
2. T1, R1 AND T2, R2 ARE OPTIONAL CUSTOMER CONNECTION TO THE TTS. THEY REPRESENT THE TIP SPRING AND RING SPRING OF THE FRONT PANEL 310 JACKS INPUT AND OUTPUT.
3. STRAP E-F TO PROVIDE OSCILLATOR WITH DC LOOP HOLDING (X) WIRING.
4. STRAPPING PER TABLE 1. USED WHEN CAD 1 IS FIRST CABLED THRU CAD 2 (2 WIRE COMBINER) THEN ON TO CAD 3.

POSITION SERVED
TABLE-1 (NOTE 4)

PIN NUMBER	POSITION INDICATED
4-5	NO POSITION SHOWN
1-2-3-5	1
1-2-4-5	2
1-2-5	3
1-3-4-5	4
1-3-5	5
1-4-5	6
1-5	7
2-3-4-5	8

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES X .X .X		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	100RZW CAD 1 FIGURE 1 TRANSMISSION TEST SET REAR VIEW	
DRAWN [illegible]	7/13/81		
CHECKED		SCALE NONE	SIZE C
ISSUE	2	DO NOT SCALE DRAWING	SHEET 3 OF 15

CAD 1
FIGURE 2



NOTES:

1. T1, R1, T2, R2, T3 AND R3 ARE OPTIONAL CONNECTIONS TO THE TTS UNIT. THEY REPRESENT THE TIP/SPRING & RING/SPRING CONTACTS OF THE FRONT PANEL ACCESS JACKS.
2. CONNECT PIN #8 TO FUSE PANEL OR OFFICE GROUND FOR NOISE TO GROUND MEASUREMENTS.
3. USE N1 AND N2 WHEN AN EXTERNAL PRECISION NET IS REQUIRED TO BE CONNECTED TO THE INTERNAL 2-WIRE HYBRID.
4. STRAPPING PER TABLE 1. USED WHEN CAD 1 IS FIRST CABLED THRU CAD 2 (2-WIRE COMBINER) THEN ON TO CAD 3.

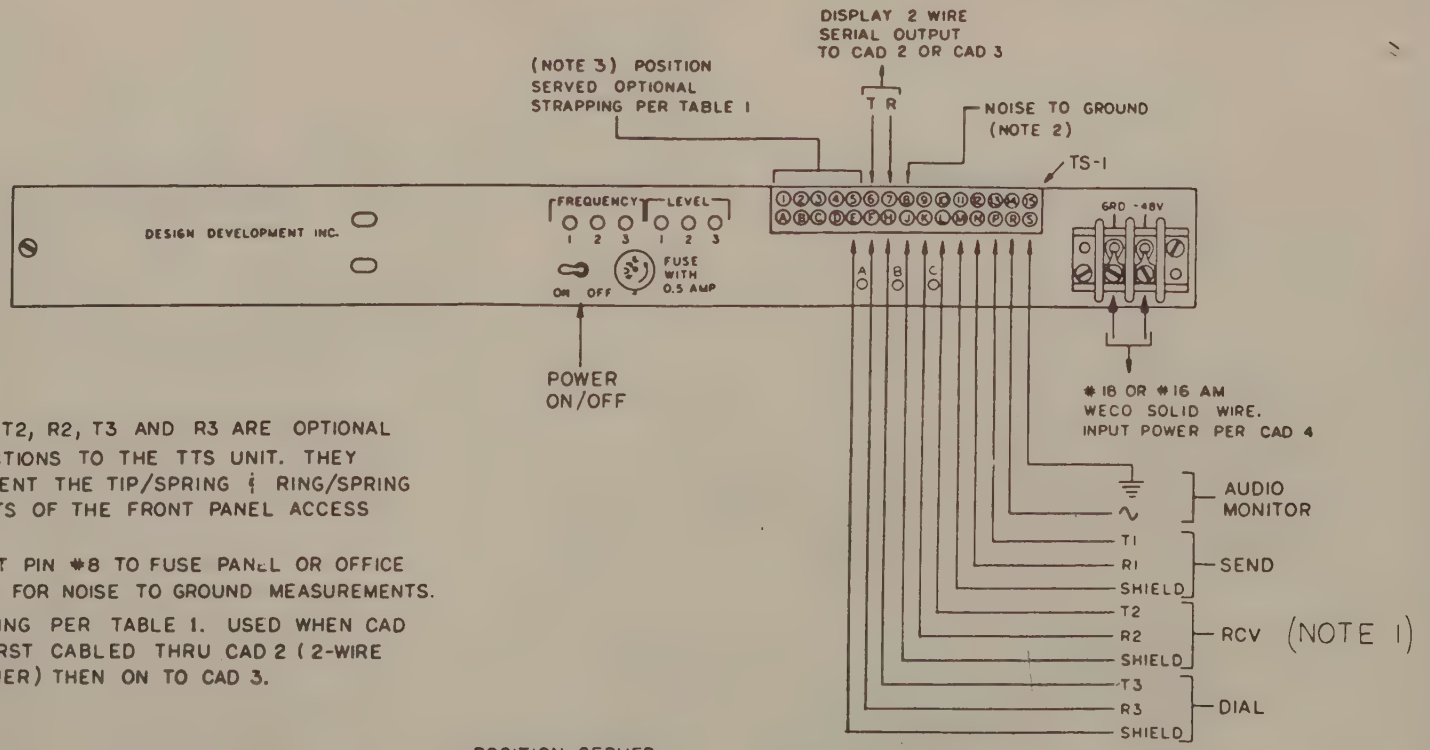
POSITION SERVED
TABLE-1 (NOTE 4)

PIN NUMBER	POSITION INDICATED
NO STRAPS	NO POSITION SHOWN
1-2-3-5	1
1-2-4-5	2
1-2-5	3
1-3-4-5	4
1-3-5	5
1-4-5	6
1-5	7
2-3-4-5	8

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		DESIGN DEVELOPMENT INC.
APPROVALS	DATE	100R-4 CAD 1 FIGURE 2 ERL TRANSMISSION UNIT REAR VIEW
DRAWN TWJ	3/13/82	
CHECKED		SCALE NONE SIZE C DRAWING NO
ISSUE	1	DO NOT SCALE DRAWING SHEET 4 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

CAD 1
FIGURE 3



NOTES:

1. T1, R1, T2, R2, T3 AND R3 ARE OPTIONAL CONNECTIONS TO THE TTS UNIT. THEY REPRESENT THE TIP/SPRING & RING/SPRING CONTACTS OF THE FRONT PANEL ACCESS JACKS.
2. CONNECT PIN #8 TO FUSE PANEL OR OFFICE GROUND FOR NOISE TO GROUND MEASUREMENTS.
3. STRAPPING PER TABLE 1. USED WHEN CAD 1 IS FIRST CABLED THRU CAD 2 (2-WIRE COMBINER) THEN ON TO CAD 3.

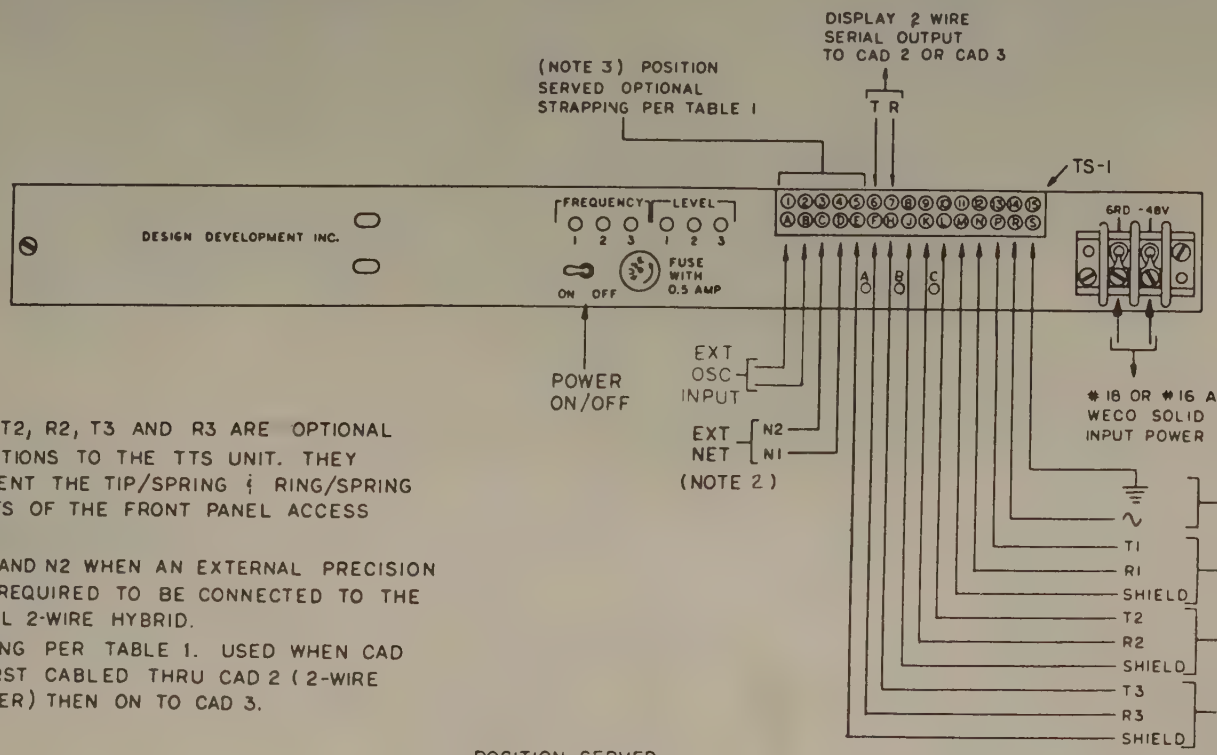
POSITION SERVED
TABLE-1 (NOTE 3)

PIN NUMBER	POSITION INDICATED
NO STRAPS	NO POSITION SHOWN
1-2-3-5	1
1-2-4-5	2
1-2-5	3
1-3-4-5	4
1-3-5	5
1-4-5	6
1-5	7
2-3-4-5	8

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	100R-5 CAD 1 FIGURE 3 TRANSMISSION UNIT REAR VIEW	
DRAWN JWJ	7/15/82		
CHECKED		SCALE NONE	SIZE C
		DRAWING NO.	
ISSUE 1		DO NOT SCALE DRAWING	SHEET 5 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

CAD 1
FIGURE 4



NOTES:

1. T1, R1, T2, R2, T3 AND R3 ARE OPTIONAL CONNECTIONS TO THE TTS UNIT. THEY REPRESENT THE TIP/SPRING & RING/SPRING CONTACTS OF THE FRONT PANEL ACCESS JACKS.
2. USE N1 AND N2 WHEN AN EXTERNAL PRECISION NET IS REQUIRED TO BE CONNECTED TO THE INTERNAL 2-WIRE HYBRID.
3. STRAPPING PER TABLE 1. USED WHEN CAD 1 IS FIRST CABLED THRU CAD 2 (2-WIRE COMBINER) THEN ON TO CAD 3.

POSITION SERVED
TABLE-1 (NOTE 3)

PIN NUMBER	POSITION INDICATED
NO STRAPS	NO POSITION SHOWN
1-2-3-5	1
1-2-4-5	2
1-2-5	3
1-3-4-5	4
1-3-5	5
1-4-5	6
1-5	7
2-3-4-5	8

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	100R-6 CAD 1 FIGURE 4 RETURN LOSS MEASURING SET REAR VIEW	
DRAWN TWT	7/19/82		
CHECKED		SCALE NONE	SIZE C
		DRAWING NO	
ISSUE	1	DO NOT SCALE DRAWING	SHEET 6 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

CAD 3
FIGURE 5

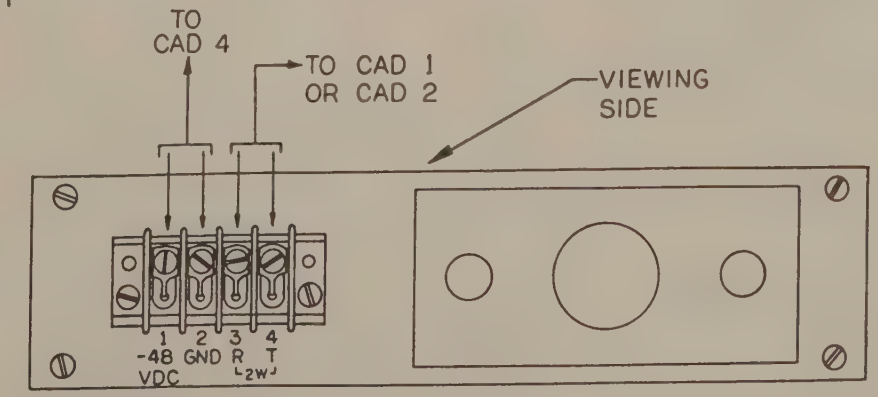


TABLE 2 (NOTE 1)
CABLING 100A2W TO 100R5/100R2W

100A2W TS-1 PIN	100R-5 OR 100R2W TS-1
3 (RING)	7 (RING)
4 (TIP)	6 (TIP)
1	FUSED -48VDC
2	FUSE PANEL GND.

NOTES:

1. 100A2W IS NORMALLY CABLED TO 100R2W OR 100R5 UNLESS OPTIONAL 2-WIRE SWITCH PANEL IS PROVIDED SUCH AS 100C-2W. FOR THIS CABLING REFER TO 100C-2W INSTALLATION MANUAL.
2. CABLING NOT TO EXCEED 10,000 FEET ANY SINGLE OR MULTIPLE RUN COMBINATIONS. UP TO 50 CAD 3 UNITS PER SINGLE INSTALLATIONS.
3. BASIC CABLE REQUIREMENTS ARE 1 PAIR 24 GAUGE UNSHIELDED.

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS ± DEC ± ANGLES ±		DESIGN DEVELOPMENT INC.		
APPROVALS	DATE	CABLING FROM 100A2W TO 100R5 OR R2W		
DRAWN JWB	12/16/81			
CHECKED		SCALE NONE	SIZE B	DRAWING NO. FIGURE 5
RBG	12/17/81			
ISSUE	1	DO NOT SCALE DRAWING		SHEET 7 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

CAD 3
FIGURE 6

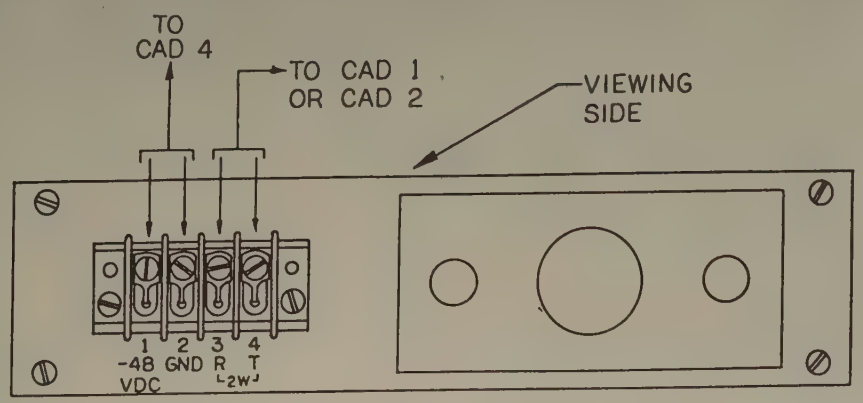


TABLE 2 (NOTE 1) CABLING 100A3 TO 100R4, 100R5 OR 100R6

100A3 TS-1 PIN	100R4, 100R5 OR 100R6 TS-1
3 (RING)	7 (RING)
4 (TIP)	6 (TIP)
1	FUSED -48VDC
2	FUSE PANEL GND.

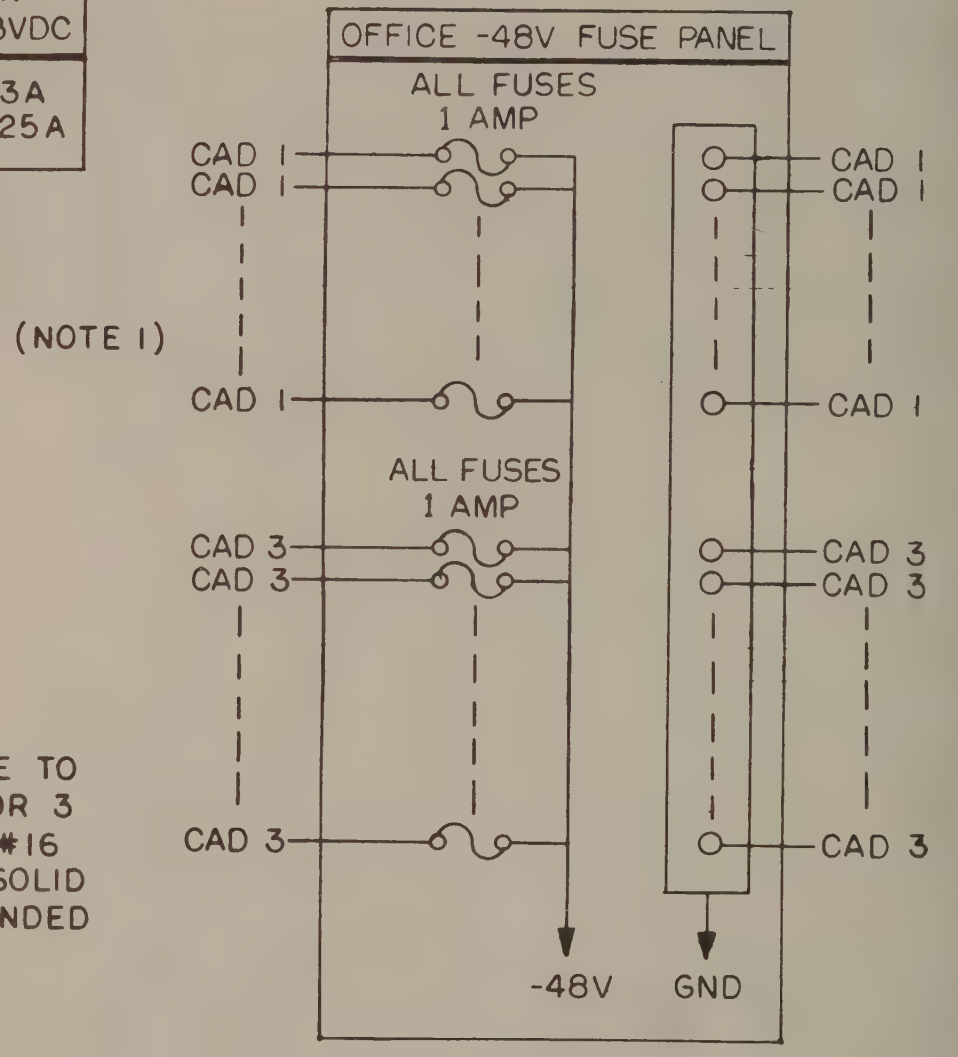
NOTES:

1. 100A3 IS NORMALLY CABLED TO 100R4, 100R5 OR 100R6 UNLESS OPTIONAL 2-WIRE SWITCH PANEL IS PROVIDED SUCH AS 100C-2W. FOR THIS CABLING REFER TO 100C-2W INSTALLATION MANUAL.
2. CABLING NOT TO EXCEED 10,000 FEET ANY SINGLE OR MULTIPLE RUN COMBINATIONS. UP TO 50 CAD 3 UNITS PER SINGLE INSTALLATIONS.
3. BASIC CABLE REQUIREMENTS ARE 1 PAIR 24 GAUGE UNSHIELDED.

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS ± DEC ± ANGLES ±		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	CABLING FROM 100A3 TO 100R4, 100R5 OR 100R6	
DRAWN JWB	12/14/81		
CHECKED		SCALE NONE	SIZE B
RBG	12/17/81	DRAWING NO. FIGURE 6	
ISSUE	1	DO NOT SCALE DRAWING	SHEET 8 OF 15

FIGURE 7

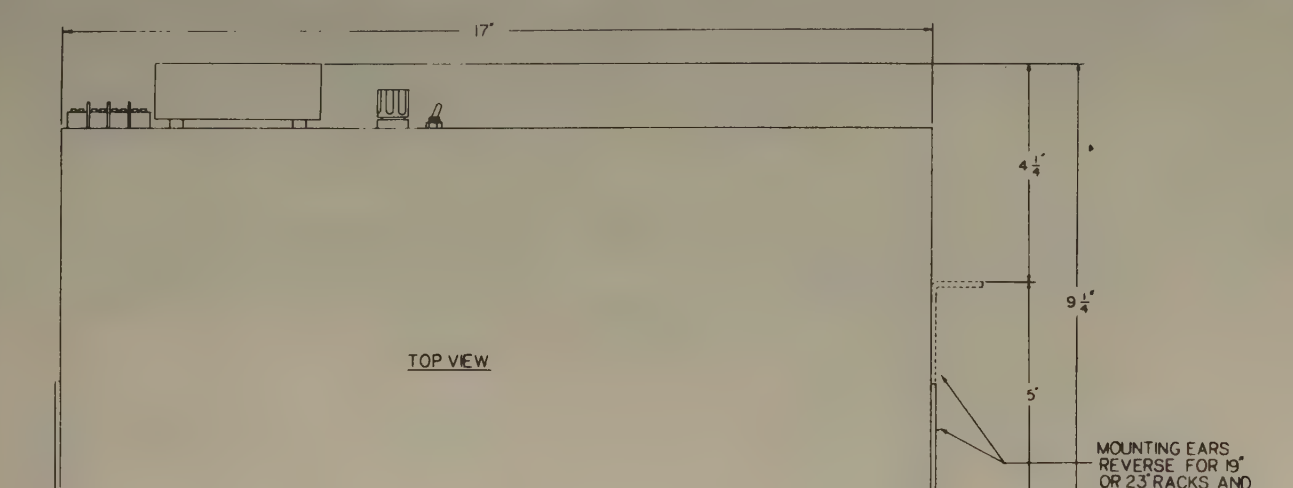
POWER DRAIN NOMINAL -48VDC
CAD 1 EA.= 0.3A CAD 3 EA.= 0.25A



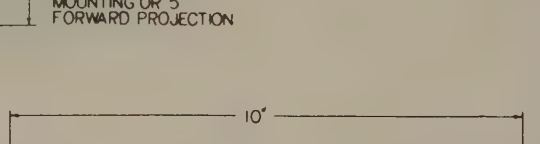
NOTE:

1. WIRE SIZE TO CADS 1 OR 3 MAY BE #16 OR #18 SOLID OR STRANDED COPPER

		DESIGN DEVELOPMENT INC.
APPROVAL	DATE	POWER CABLING
JWB	12/16/81	
RBB	12/17/81	SCALE NONE — FIGURE 7
ISSUE	1	SHEET 9 OF 15

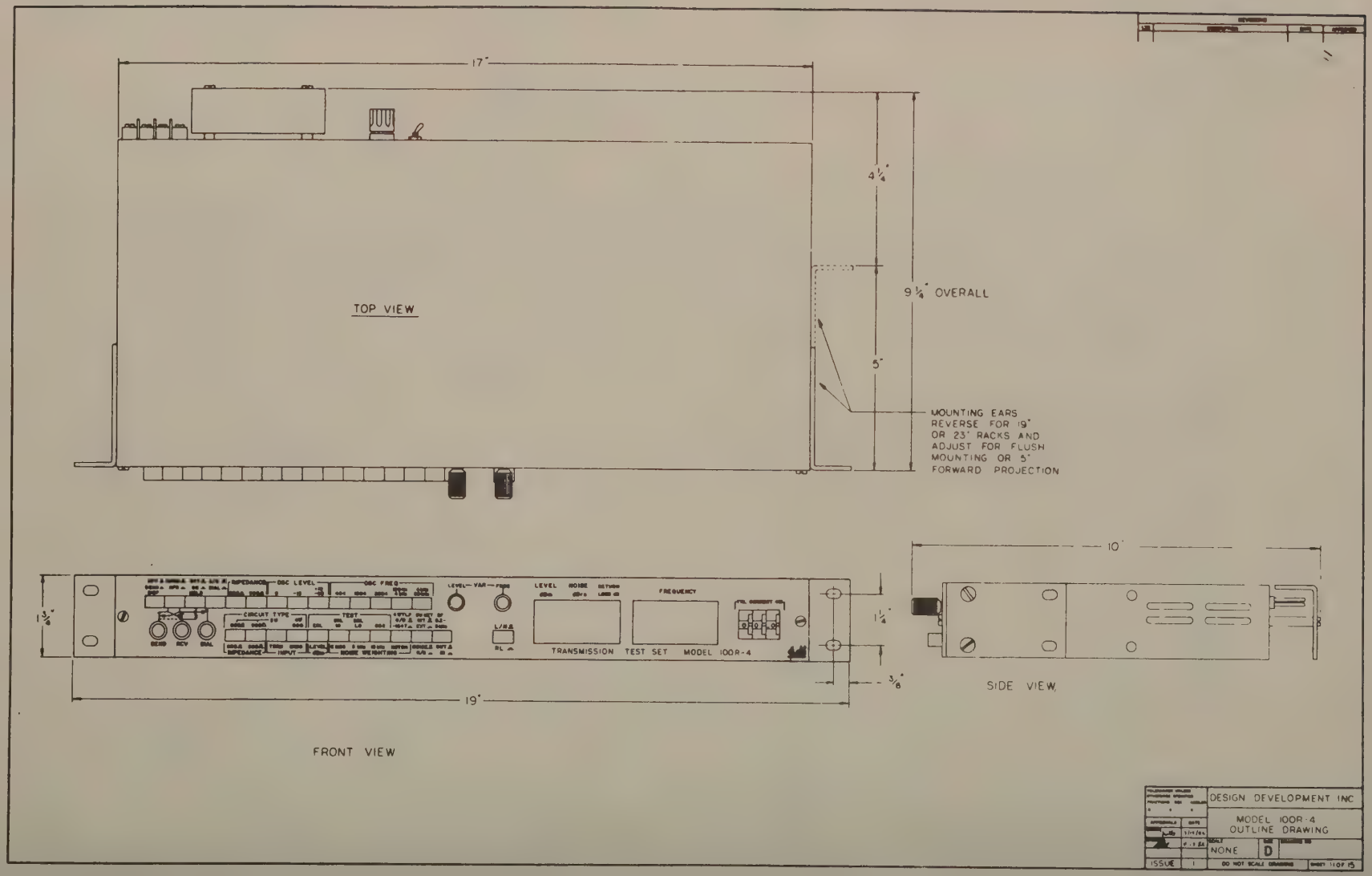


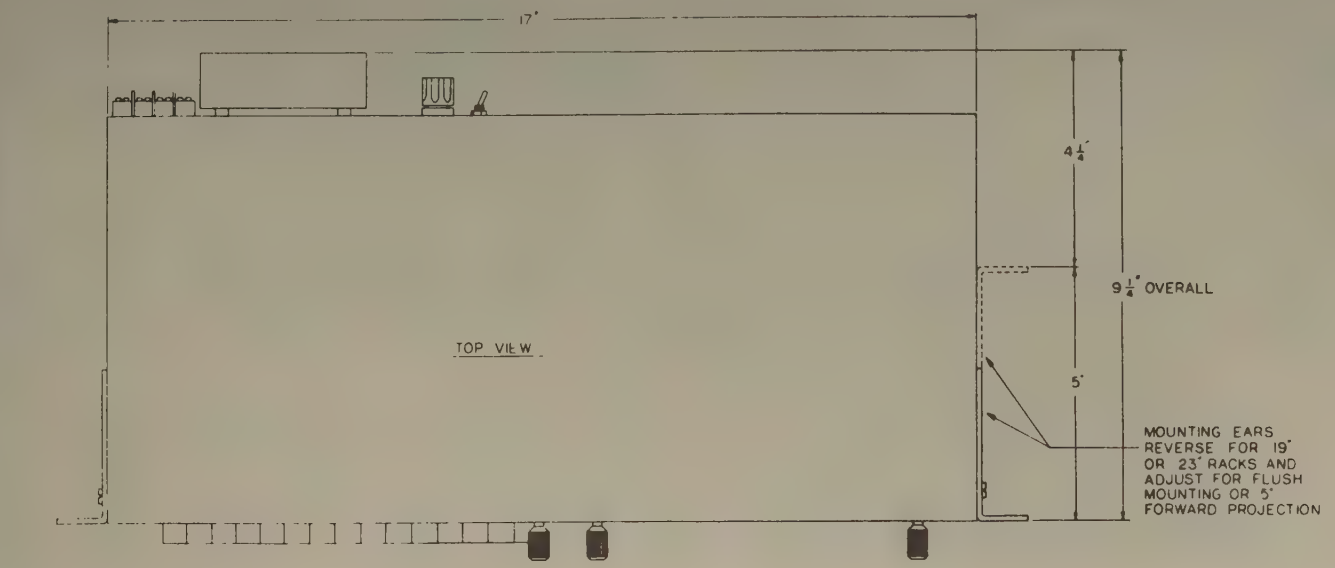
FRONT VIEW



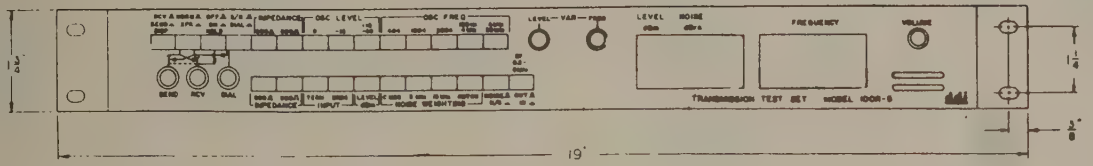
SIDE VIEW

DESIGN DEVELOPMENT INC	
MODEL 100R 2W OUTLINE DRAWING	
NONE	D ISSUE #3
DO NOT SCALE DRAWING	SHEET 10 OF 15

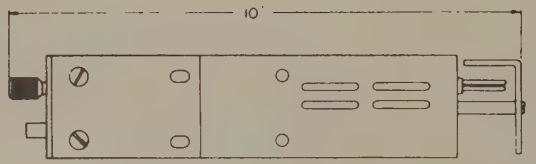

17"
4 1/4"
9 1/8" OVERALL
5"
MOUNTING EARS REVERSE FOR 19" OR 23" RACKS AND ADJUST FOR FLUSH MOUNTING OR 5" FORWARD PROJECTION
TOP VIEW
TRANSMISSION TEST SET MODEL 100R-4
1 3/4"
19"
FRONT VIEW
10"
1 1/4"
3/8"
SIDE VIEW
DESIGN DEVELOPMENT INC
MODEL 100R-4
OUTLINE DRAWING
NONE
D
ISSUE 1
DO NOT SCALE DRAWING



TOP VIEW

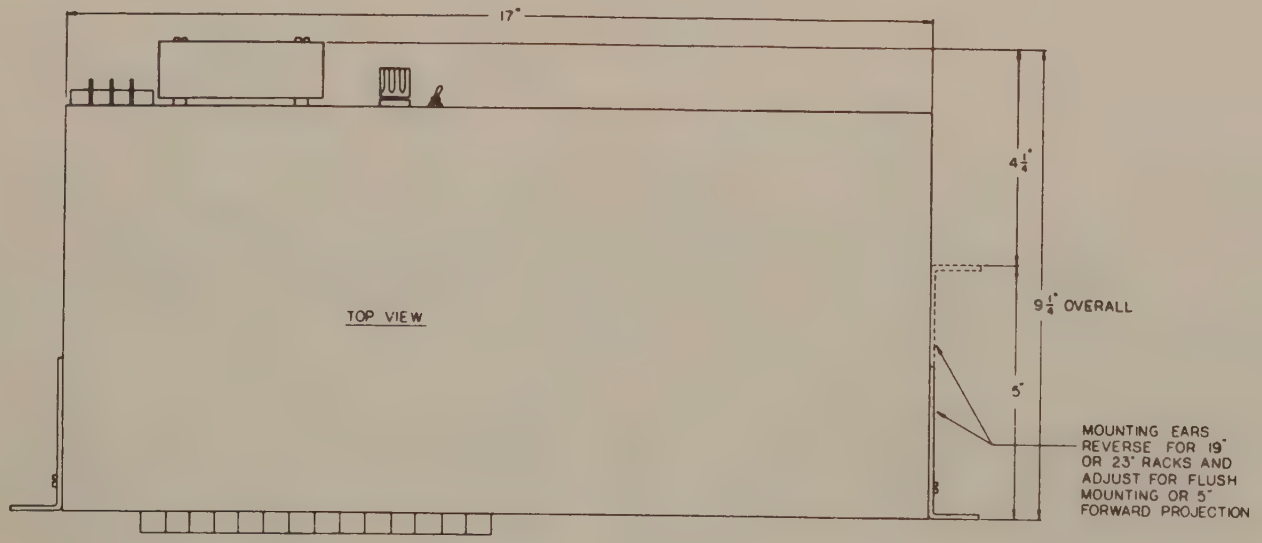


FRONT VIEW

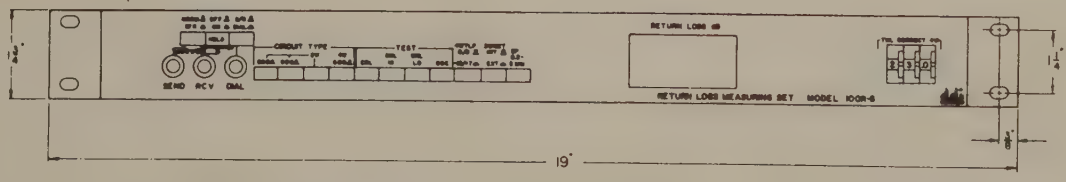


SIDE VIEW

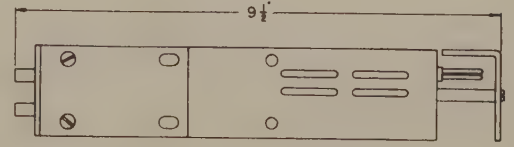
DESIGN DEVEOPMENT INC		
4/9/84	TWB	9-19-83
NONE		
MODEL 100R-5 OUTLINE DRAWING		
ISSUE 1		SHEET 2 OF 13



TOP VIEW

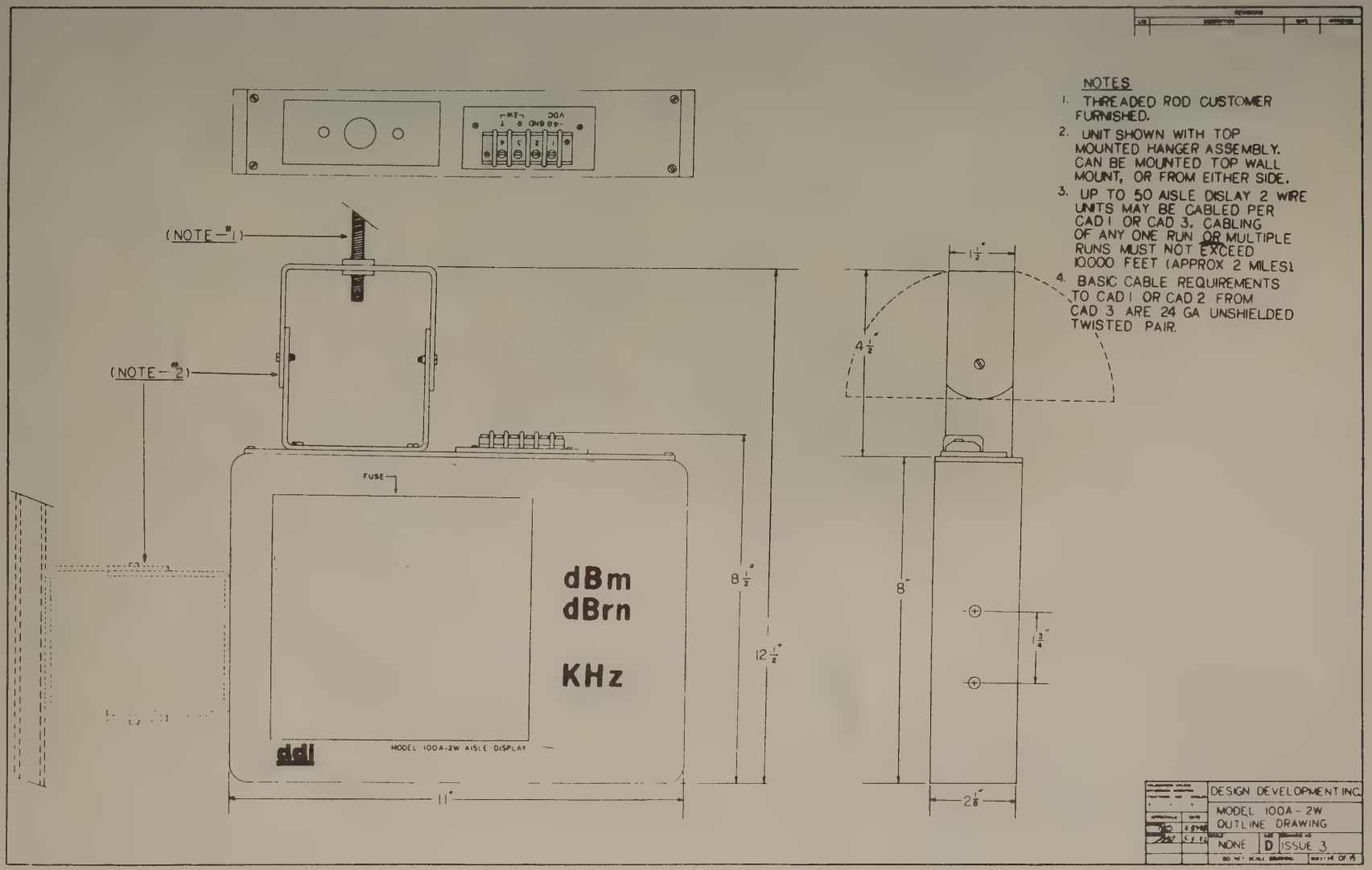


FRONT VIEW



SIDE VIEW

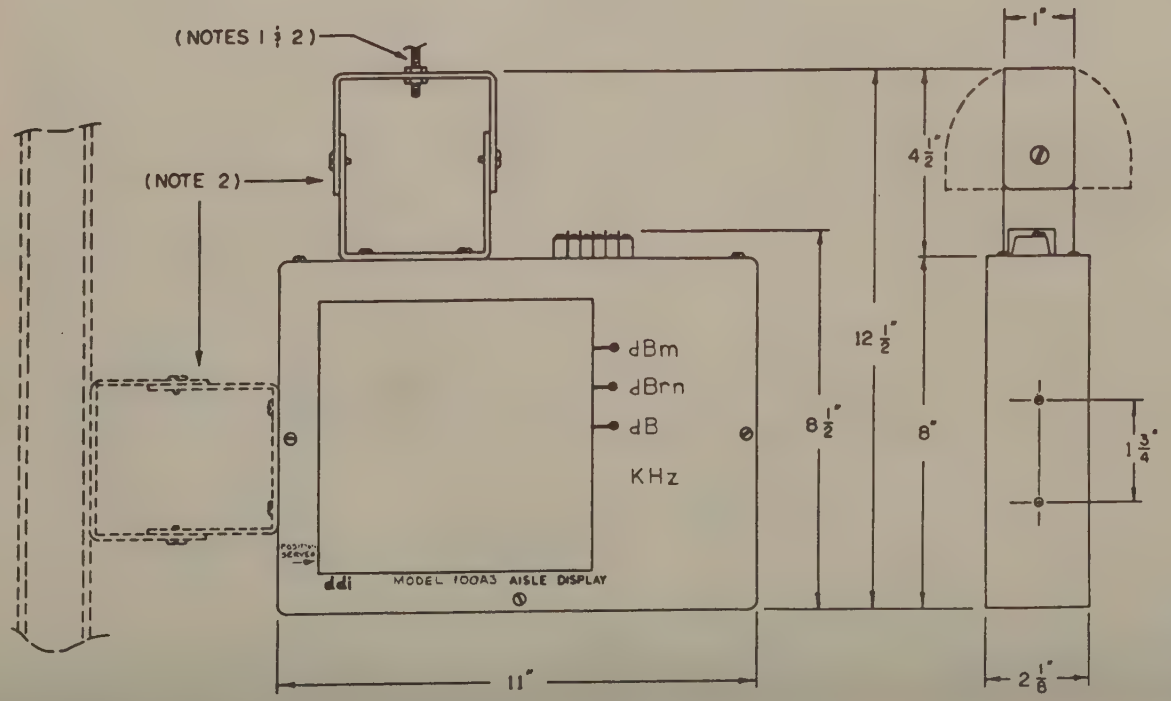
DESIGN DEVELOPMENT INC.	
MODEL 100R-6 OUTLINE DRAWING	
SCALE NONE	SIZE D
ISSUE 1	DO NOT SCALE DRAWING SHEET 1 OF 1


NOTES
1. THREADED ROD CUSTOMER FURNISHED.
2. UNIT SHOWN WITH TOP MOUNTED HANGER ASSEMBLY. CAN BE MOUNTED TOP WALL MOUNT, OR FROM EITHER SIDE.
3. UP TO 50 AISLE DISLAY 2 WIRE UNITS MAY BE CABLED PER CAD 1 OR CAD 3, CABLING OF ANY ONE RUN OR MULTIPLE RUNS MUST NOT EXCEED 10000 FEET (APPROX 2 MILES)
4. BASIC CABLE REQUIREMENTS TO CAD 1 OR CAD 2 FROM CAD 3 ARE 24 GA UNSHIELDED TWISTED PAIR.
(NOTE #1)
(NOTE #2)
FUSE
dBm
dBrn
KHz
ddi
MODEL 100A-2W AISLE DISPLAY
11"
8 1/2"
12 1/2"
1 1/2"
4 1/2"
8"
1 3/4"
2 1/8"
DESIGN DEVELOPMENT INC.
MODEL 100A - 2W
OUTLINE DRAWING
NONE
D
ISSUE 3

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

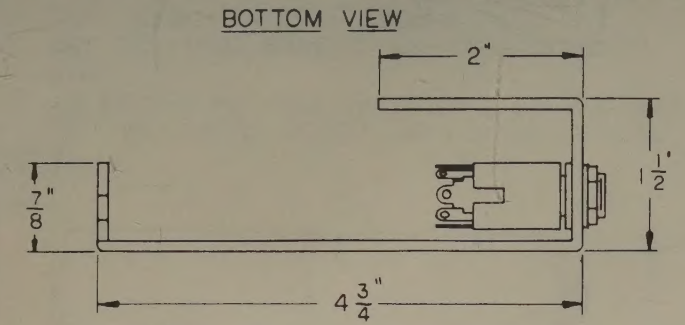
NOTES:

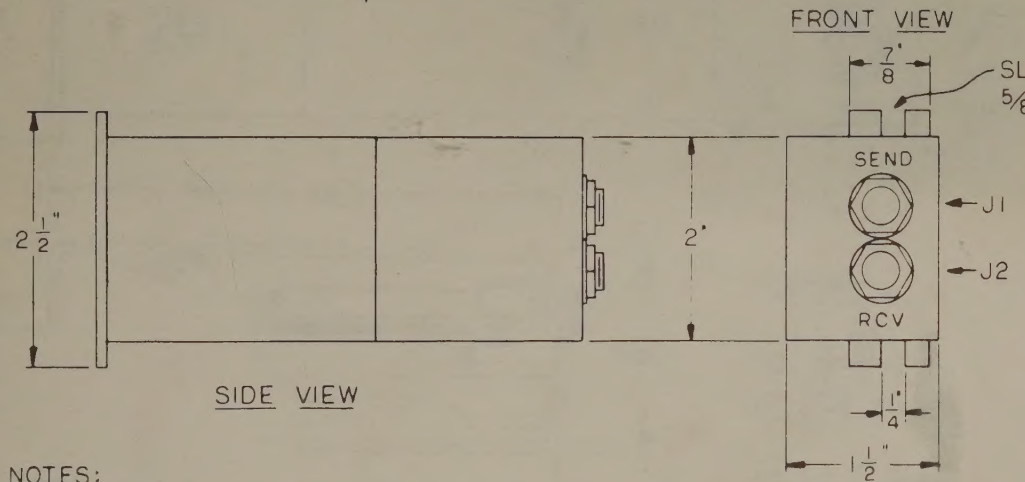
1. THREADED ROD CUSTOMER FURNISHED.
2. UNIT SHOWN WITH TOP MOUNTED HANGER ASSEMBLY. CAN BE WALL MOUNTED, OVERHEAD MOUNTED OR BAY MOUNTED FROM EITHER SIDE.
3. UP TO 50 AISLE DISPLAY UNITS MAY BE CABLED PER CAD 1 OR CAD 3. CABLING OR ANY ONE RUN OR MULTIPLE RUNS MUST NOT EXCEED 10,000 FEET (APPROX. 2 MILES).
4. BASIC CABLE REQUIRMENTS TO CAD 1 OR CAD 2 FROM CAD 3 ARE 24 GA UNSHIELDED TWISTED PAIR.

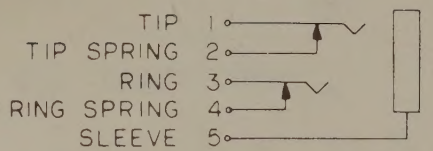


TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES		DESIGN DEVELOPMENT INC.	
APPROVALS	DATE	100A3 OUTLINE DRAWING	
DRAWN Tjb	11/17/81		
CHECKED	12/10/81	SCALE NONE	SIZE C
ISSUE	1	DO NOT SCALE DRAWING	SHEET 15 OF 15

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED





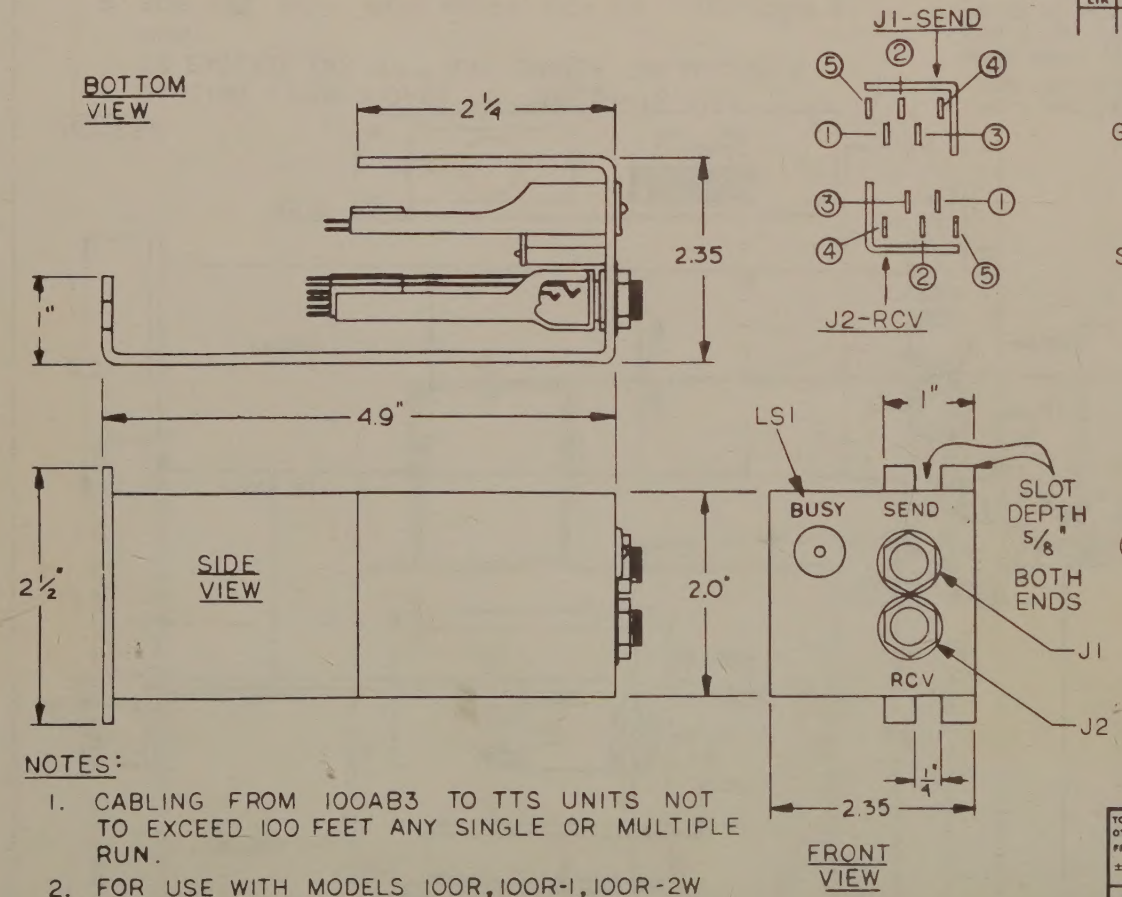


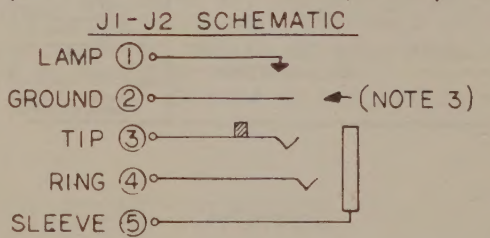
J1-J2 SCHEMATIC

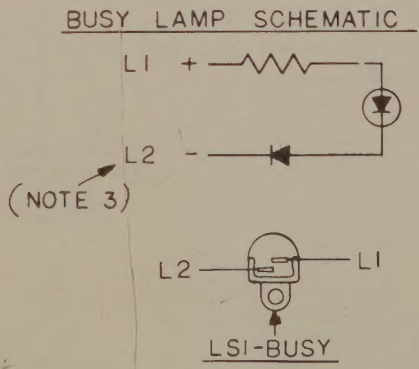
NOTES:

1. CABLING FROM 100ABI TO TTS UNITS NOT TO EXCEED 100 FEET ANY SINGLE OR MULTIPLE RUN.
2. FOR USE WITH 100R, 100R-1, 100R-2W, 110R, 100R-4 100R-5 & 100R-6

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		DESIGN DEVELOPMENT INC		
APPROVALS	DATE	MODEL 100ABI REMOTE BRACKET OUTLINE		
DRAWN JWJ	7/15/82			
CHECKED		SCALE NONE	SIZE B	DRAWING NO
		DO NOT SCALE DRAWING		SHEET 15A





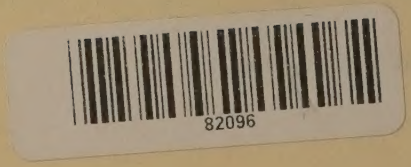


NOTES:

1. CABLING FROM 100AB3 TO TTS UNITS NOT TO EXCEED 100 FEET ANY SINGLE OR MULTIPLE RUN.
2. FOR USE WITH MODELS 100R, 100R-1, 100R-2W 110R, 100R-4, 100R-5 & 100R-6
3. CONNECT J1, PIN 2 TO OFFICE GROUND AND L2 (LAMP) TO FUSED -48VDC.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DEC ANGLES ± ± ±		DESIGN DEVELOPMENT INC		
APPROVALS	DATE	MODEL 100AB3 REMOTE BRACKET OUTLINE		
DRAWN [illegible]	7/28/81			
CHECKED		SCALE NONE	SIZE B	DRAWING NO. 100AB3
		DO NOT SCALE DRAWING		SHEET 15B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